OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as "developed", "industrialized" and "developing" are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

58p
tables
diagrams
images
illus

5

PREFEASIBILITY STUDY

ON

THE ESTABLISHMENT OF AN INDUSTRIAL SCALE PENICILLIN PLANT

PROJECT NO DG/PHI/86/014
CONTRACT NO 91/80

on behalf of

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION
PO BOX 300
A-1400 VIENNA
AUSTRIA

FEBRUARY 1992

Manderstam Consulting Services
2/10 Harbour Yard
Chelsea Harbour
London SW10 0XD

Tel: 071 730 9224
Fax: 071 823 3056
Tlx: 24787 Mander G

THE ESTABLISHMENT OF AN INDUSTRIAL SCALE PENICILLIN PLANT

PREFEASIBILITY STUDY - VOLUME I

CONTENTS

12. **FINANCIAL EVALUATION : OPTION C**

Total Investment Costs
Project Financing
Production Costs
Financial Evaluation

13. **ECONOMIC ANALYSIS**

Assessment of Options
Economic Analysis

SECTION 1

EXECUTIVE SUMMARY

1.1 PROJECT BACKGROUND AND HISTORY

1.1.1 The aim of this prefeasibility study is to provide the Government of the Philippines with a basis for rational decision making concerning three possible options in antibiotics production. This will be accomplished by investigating the commercial profitability and economic viability of three options:

a) Production of Penicillin G, 6-APA, semi-synthetic penicillin, and formulation and packaging of dosage forms;

b) Importation of Penicillin G and production of 6-APA and downstream products specified in a) above.

c) Production of Penicillin G and 6-APA only.

1.1.2 In May 1991, the United Nations Industrial Development Organisation (UNIDO) commissioned Manderstam Consulting Services to prepare a prefeasibility study in respect of these project proposals, as per the terms of reference presented at Appendix 1-1.

1.1.3 The field work which formed much of the basis of this appraisal was undertaken in May and June 1991, and the assistance and cooperation received from all those concerned in the Philipines is hereby gratefully acknowledged.

1.1.4 The initiatior of this project, together with previous UNIDO studies is the Ministry of Health in the Philippines Government, whoose address is:-

San Lazaro Compound, Rizal Avenue, Santa Cruz, Manila, Philippines, telephone 711-6771/711-6105

1.2 PROJECT BACKGROUND

1.2.1 Penicillin is a very important strategic product which can take several forms both as an intermediate bulk chemical and in final dosage form. The manufacturing route has four stages with respective products and is summarised below:-

Stage 1

Penicillin G	-	Produced by fermentation and is primarily used as a feedstock to convert to 6-APA.

Stage 2

Bulk 6-APA	-	This is the basic feedstock for a wide range of bulk semi-synthetic penicillin.

Stage 3

Bulk Semi-Synthetic Penicillin	-	The principal semi-synthetics required in the Philippines are ampacillin, amoxycillin and cloxacillin

Stage 4

Final Dosage Form	-	The bulk semi-synthetic are finally mixed with excipients and turned into final dosage forms by 'compounding' companies.

1.2.2 At the time of this study stages 1 and 2 of this production chain are not carried out in the Philippines. Only one firm is engaged in stage 3, Chemfields. There are approximately 250 companies licensed to compound drugs (stage 4). Where local manufacture is not available than the particular product is imported into the Philippines.

1.2.3 During the preparation of this feasibility study, the following major parameters were taken into consideration:-

- domestic and export market potential
- intended and anticipated future therapeutic use of the products
- prospects of developing a Philippine-based bulk pharmaceutical industry
- a location close to ports, University of the Philippines, raw materials and the existing distribution system.
- plant capacity based upon existing demand and forecasted future demand for the Philippines.
- maximum use of locally produced raw materials, especially cane sugar and corn steep liquor
- following the request of the Philippine Minister of Health, the implementation of the project would take place after a decision in 1992. Under these circumstances, the plant could start-up in 1995.

1.3 MARKET AND PLANT CAPACITY

1.3.1 It is estimated that penicillins account for over 50% of the total demand for antibiotics in the Philippines. Ampicillin and amoxycillin respectively account for 32% and 30% of demand by value, the natural penicillins for a further 14% and cloxacillin for 8%. No other semi-synthetic penicillin represents more than 5% of demand.

1.3.2 On balance, the private and public sector demand statistics obtained were considered to be neither sufficiently comprehensive nor precise enough to provide a reliable basis for estimating the size and development potential of the market. Analysis of market size therefore concentrated on the supply data relating to domestic production and imports of pharmaceuticals.

1.3.3 Total market demand for the selected forms of natural and semi-synthetic penicillins, expressed in terms of the weight of active ingredient, has been assessed at approximately 163 tonnes in 1990:

	Domestic Production	Imports	Unrecorded Imports	Total Demand
Natural Penicillins				
Penicillin-G	-	19	1	20
Penicillin-V	-	23	1	24
Semi-Synthetics				
Ampicillin	47	2	2	51
Amoxycillin	32	20	8	60
Cloxacillin	8	-	-	8
	87	64	12	163

1.3.4 Although the pattern of individual demand is not consistent, it is estimated that private sector demand accounts for 80% to 85% of drug purchases as a whole.

1.3.5 The total drug market expanded by just under 5% per year during the last decade, and at 5.5% over the last five years. However, broad spectrum antibiotics have grown at above average rates, with government purchases increasing at an annual average of about 10% in real terms.

1.3.6 Continued population growth will be the main factor in determining the future demand for antibiotics, followed by the priority now being given to expenditure on health care and drugs and the shift in prescription patterns to reflect the changing health profile of the population. Based on the growth factors identified for each individual product, demand is expected to increase as follows :

Tonnes	**1990**	**1995**	**2000**	**2005**	**2010**
Pen-G (feedgrade)	8	9	11	13	15
Pen-G & Pen-V	36	40	43	43	45
Ampicillin	51	47	40	34	29
Amoxycillin	60	107	151	191	242
Cloxacillin	8	12	19	28	41

1.3.7 On the basis of our assessment of the market potential, as well as existing and expected competition, the project should achieve the following target levels of market penetration :

	1995	**1997**	**2000**	**2005**	**2010**
Natural Penicillins	18%	55%	91%	89%	87%
6-APA	35%	59%	49%	46%	35%
Bulk Semi-Synthetics	10%	19%	25%	25%	25%
Final Dosage Forms	0.5%	1.3%	2%	2%	2%

1.3.8 Although consideration should be given to developing an export trade in the longer term, the plant should initially be planned and costed for supplying the domestic market only :

a) The bulk chemical market is limited in size, very competitive and there is considerable over-capacity at the present time.

b) It could prove difficult to break into the market for final dosage forms owing to the trade policies of many developing nations and the need to first gain the approval of a recognised authority such as the United States Food and Drug Administration.

1.3.9 The individual marketing strategies recommended may be summarised as follows :

Natural Penicillins
The company should concentrate on selling in bulk to the major importers of feedgrade penicillin, and to the established manufacturers of pharmaceutical products.

6-APA
Part of the total output of 6-APA would be kept as the basic feedstock raw material for further processing in-house, and the balance would be sold to the three other domestic producers of semi-synthetic penicillins.

Bulk Semi-Synthetics
Given that the established competition in the market could make it very difficult for a new entrant, the company should aim to secure its place through close customer liaison and by offering superior technical advice and support as part of its sales service.

Final Dosage Forms
The company should concentrate on supplying generic products to the private sector in order to secure a 2% share of the overall market for final dosage forms. The distribution function would be delegated to one or more of the specialist wholesalers, but it would still be necessary to operate a national sales force in order to establish direct contact with the end-user.

1.3.10 Projected sales revenues for each of the three manufacturing options under review may be summarised as follows (in Pesos '000) :

	1995	2000	2005	2010
Option A				
Pen-G	10,400	57,200	57,850	60,450
6-APA	96,876	175,094	203,619	192,317
Bulk Product	38,610	123,240	148,356	185,354
Dosage Forms	10,079	53,955	66,920	82,613
	155,965	409,489	476,745	520,734
Option B				
6-APA	105,667	222,635	252,057	242,728
Bulk Product	38,610	123,240	148,356	185,354
Dosage Forms	10,079	53,955	66,920	82,613
	154,356	399,830	467,333	510,695
Option C				
Pen-G	10,400	57,200	57,850	60,450
6-APA	117,328	240,575	281,299	287,937
	127,728	297,775	339,149	348,347

1.3.11 Production schedules and plant capacity for each of the three manufacturing options are set out in Appendix 3-30 and by way of example, Option A is set out below for years 1995 to 1990.

Option A	1995	1996	1997	1998	1999
Maximum Possible Output	286	286	286	286	256
Capacity Utilisation	45.5%	72.7%	90.9%	90.9%	90.9%
Production Schedule (Pen G equivalent)	130	208	260	260	260
Pen G feedgrade	2.0	4.0	6.0	8.0	10.0
Pen G human grade	7.0	15.0	22.0	30.0	39.0
6-APA	99.0	156.3	187.9	166.3	147.4
Bulk Ampicillin	6.0	3.4	9.6	12.0	12.0
Bulk Amoxycillin	13.1	20.2	28.6	25.7	41.7
Bulk Cloxacillin	1.1	2.1	3.2	4.2	5.3
Final Dosage Ampicillin	0.2	0.5	0.7	0.8	1.0
Final Dosage Amoxycillin	0.6	1.4	1.3	1.6	3.3
Final Dosage Cloxacillin	0.1	0.1	0.2	0.3	0.4

1.4 MATERIAL AND INPUTS

1.4.1 Raw materials required for options A and C are local supplies of sugar and corn steep liquor for the fermentation process and fuel for steam generation. In addition, a range of about 30 different specialist inorganic and organic chemicals and solvents must be imported.

1.4.2 For the fermentation process, the cost of materials is most important and constitutes a major proportion of product manufacturing cost. A significant factor is the availability of only 6% concentrated corn steep liquor. Additional costs of $8 per kg are then incurred in evaporating this to the required 50% concentration.

1.4.3 Option B does not require local feedstock supplies but is largely dependent on the importation of Penicillin G together with the specialist chemicals referred to above.

1.4.4 The annual supply requirements of the principal local raw materials are summarised below:-

Consumption of Philippine Raw Materials

Options A and C only*
(units: tonnes per year)

	1995	2000	2005	2010
Soy Bean Oil	747	1,685	1,933	1,977
Sucrose solution 50%	1,459	3,289	3,775	3,861
Corn steep liquor 6%	25,766	58,108	66,691	68,208

* option B requires none of the above materials since all products are made from imported penicillin).

1.4.5 The annual supply requirements of imported raw materials are summarised below:-

Consumption and Prices of Imported Raw Materials

(Costs based on delivered prices, duty paid. All costs and consumptions approximate)

		Price $/tonne	Requirements tonnes/year		
	option	1991	2000	2005	2010
Calcium carbonate	A,C	270	1778	2035	2206
Ammonium sulphate	A,C	30	1666	1965	1809
Butyl acetate	A,C	1500	1111	1571	1655
Sodium sulphate	A,C	145	1111	1309	1379
Phenyl acetic acid	A,C	1100	1000	1179	1242
Ammonia anhydous	all	185	1000	1179	1242
Methylisobutylketone	A,B	825	922	1087	1145
Acetone	all	1170	422	498	524
Hydrochloric acid 30%	all	90	278	327	344
Butanol	A,C	1166	278	441	465
Potassium hydrogen phosphate	A,C	1990	111	130	137
Sodium bicarbonate	A,C		100	118	124
Dichloromethane	all	900	50	58	68
Phenyl glycine	A,B	25600	28	32	37
Ethylacetoacetate	A,B	3250	22	26	30
P-hydroxyphenylglycine	A,B	25000	22	26	30
Ethyl chloro carbonate	A,B	17400	22	26	30
Tri ethylamine	A,B	3900	17	17	20
Ethanol anhydrous	A,B	1200	5	7	7
Active charcoal	all	nk	4	5.1	6
Sodium hydroxide	A,B	9660	nk		
Ethyl hexanoate	A,B	3250	2	3	4
Chlorophenylmethyl-isoxazolycarboxilic acid	A,B	tba	2	2	2

1.4.6 The following public utilities are required:-

Option	Power MW Public	Power MW Standby	Public Water Cum per Hr
A	8.2	8.0	180
B	0.5	0.5	10
C	8.0	8.0	180

1.5 **LOCATION AND SITE**

1.5.1 A site was found in the Light Industry and Science Park of the Philippines in Canubang in the Calabarzon region, 35km south of Metro Manila.

1.5.2 The Light Industry and Science Park is a 142 hectare prepared site divided into 1 hectare lots. All lots are fully serviced with roads and public utilities, Options A and C require 1 hectare and Option B, 0.5 hectare.

1.5.3 Particular features worthy of note are:-

- good quality water supply from deep wells,complete with a 3,200 cu m storage tank for a total supply of 500 cu m per hour.
- Electric power is provided by the Manila Electric Company. Approximately 80 MW capacity is available for the site and in Summer 1991 most of this had not yet been allocated, hence there was more than enough for the maximum power of 8MW foreseen for Options A and C on this project. A sub-station is required and this has been costed in our estimates.
- 500 telephone lines are provided by the Philippine Long Distance Telephone Company.
- There is an existing waste water treatment plant facility, the details of which were not available at the time of the survey. A additional allowance for waste water treatment has been made in the capital cost estimates to cover this point.
- There is a common site Customs bonded Zone.
- Public services include; security force, post office, and clinic, bank, restaurants, recreation park.

1.6 **PROJECT ENGINEERING**

1.6.1 The scope of the project is to present the design of a modern plant able to produce the specified chemicals in bulk and final form to internationally acceptable standards of quality and productivity.

1.6.2 Each process has been evaluated to ensure it is up to date, and the preliminary engineering design has been developed in sufficient detail to ensure that project costs are accurate to ±15%.

1.6.3 The major processing units are summarised below:-

Diagram Nos (Appendix 6-1 and 6-2)		Option
1	Media Preparation	A,C
2	Additive preparation	A,C
3	Penicillin fermentation	A,C
4	Downstream (penilcillin) recovery	A,C
5	Penicillin purification	A,C
6	6-APA production - diagram 6 only	A,B,C
7	Dane salt preparation	A,B
8	Amoxcillin/Ampicillin production	A,B
9	Cloxacillin production	A,B
10	Dosage production	A,B

1.6.4 The process technology selected here to manufacture penicillin G follows a classical process which is indeed very similar to that used to make all bulk antibiotics.

1.6.5 Particular features may be summarised as follows:-

- Use of high productivity strain, for Penicillin G manufacture
- Utilises the batch fermentation process in $100cm^3$ vessels
- Uses classical centrifugal extractors,

1.6.6 There are no important patents held for these processes. However in practice the details of their commercial operation in this report are still a commercial secret. There is thus a requirement to seek a technical partner especially for assistance in the manufacture of Penicillin G. Hindustan Antibiotics Ltd of India have been put forward as a reputable partner.

1.6.7 Similarly it is important to maintain the productivity of the plant by gaining access to a high yielding strain of penicillin through a collective strain development programme operated by Panlabs Company of the USA and Taiwan.

1.6.8 The equipment is manufactured from high quality and expensive materials of construction for example, polished stainless steel in order to meet international pharmaceutical standards.

Whilst most of the equipment can be delivered within six months, certain items are highly specialised in design and expensive to manufacture and with a handful of competent manufacturers worldwide. Hence up to nine months has been allowed for delivery of the following:-

- compressors: oil and moisture free air, 1MW capacity
- agitators: stainless steel, 10m shaft length, 250kW motor
- centrigugal extractors, stainless steel,
- fermenters, stainless steel, jacketed, 100 cu m capacity

1.6.9 Civil engineering requirements for each of the options are summarised below. All of the buildings can be constructed by locally based contractors.

Summary of Buildings and Civil Works

facility	type	option A sq m	option B sq m	option C sq m
fermentation	1	1 [illegible]	-	1 [illegible]
extraction	2	400	-	400
6-APA	2	400	400	400
pilot plant	2	[illegible]	-	[illegible]
laboratory	3	[illegible]	[illegible]	[illegible]
utilities	1	1 600	300	1 600
warehousing	1	400	400	400
offices	3	[illegible]	[illegible]	[illegible]

Type 1 buildings consist of uninsulated steel frame with clad walls and roof, concrete floor, access doors for heavy equipment, steel support frames for process equipment and standard electrical equipment.

Type 2 buildings as 1 above except explosion proof electrical equipment
Type 3 buildings are 2 or 3 storey buildings, insulated, brick or clad construction, steel framed, air conditioned, wc's, wash rooms, canteens, rest areas included.

1.7 **MANPOWER**

1.7.1 Various levels of technical and business trained personnel are required for all three options of this project, and as the technologies will be entirely new to the Philippines, the need for good well trained technical personnel is of paramount importance.

1.7.2 The head count for the three options is set out below

Proposed Head Count - Summary

Grade	Option A	Option B	Option C
Senior Management	5	5	4
Departmental Managers	9	9	5
Direct Production Staff			
Penicillin and 6-APA	61	23	61
Bulk Semi-Synthesis	28	23	-
Final Dosage Forms	19	19	-
Laboratory and Engineering Staff	79	32	79
Administration Staff	34	34	34
Sales Personnel	40	40	1
Total	275	195	184

1.8 **IMPLEMENTATION SCHEDULE**

1.8.1 On the basis that approval to proceed is given by the end of the third quarter 1992 and a award of contract is made to an international contractor by the end of the first quarter 1993, the commissioning would be completed by December 1994 with production commencng January 1995. It is envisaged that full production would be achieved by the end of 1996.

1.9 **FINANCIAL EVALUATION : OPTION A**

1.9.1 The initial investment cost of Option A has been estimated at a total of P 1,657.5 million, equivalent to approximately US$ 63.75 million. 74% of this total would be payable in foreign currency :

Initial Fixed Investment Costs			
- Land	:	P	13,200
- Site Preparation	:	P	7,150
- Structures/Civil Works	:	P	454,914
- Incorporated Fixed Assets	:	P	55,876
- Machinery and Equipment	:	P	591,206
		P	1,122,346
Pre-Production Expenditures	:	P	411,183
Working Capital Requirement	:	P	123,976
Total	:	P	1,657,505

1.9.2 The financing arrangements proposed for Option A would result in an acceptable debt:equity ratio of 1.46:1 at project implementation, and are summarised as follows :

Equity Capital			
- Project Promoters	:	P	403,736
- Financial Agencies	:	P	269,158
Long-Term Borrowings			
- Foreign Currency	:	P	938,787
- Local Currency	:	P	45,824
Current Liabilities			
- at full capacity	:	P	24,730
Total	:	P	1,682,235

1.9.3 It has been assumed that the local project promoters would wish to retain an overall majority interest, consequently the participation of external financial institutions/agencies has been limited to 40%.

1.9.4 Expenditures on raw material inputs and utilities have been calculated by reference to clearly specified usage and cost figures per individual input, and provide the basis for estimating the unit cost of each of the products to be manufactured in terms of Option A. Comparison of these unit costs with the anticipated maximum selling prices highlights the fact that the project would produce both Pen-G feedgrade and 6-APA at a gross loss :

per kg	Input Cost	Sales Price	Gross Margin	% Margin
Pen-G (feedgrade)	905	650	(255)	(39%)
Pen-G (clinical)	905	1,300	395	30%
6-APA	1,916	1,794	(122)	(7%)
Ampicillin	1,981	2,002	21	1%
Amoxycillin	2,008	2,340	332	14%
Coxacillin	1,890	2,860	970	34%

1.9.5 On the basis of the 5-year financial projections prepared, Option A would not appear to be a feasible proposition :

a) The project would record an operating loss in each year, due to the fact that the estimated input costs in respect of two out of five products exceed the selling prices assumed. Accumulated losses would exceed the equity capital by the third year of operation, at which point Option A would be technically bankrupt.

b) By the end of the 5-year period, the accumulated losses would total nearly P 1,225 million, and the cumulative cash shortfall would exceed P 1,290 million.

1.9.6 Two alternative scenarios were prepared to ascertain what changes would be necessary to enable the project to break-even after five years. These confirmed that sales prices would have to increase by a minimum of 48% over and above the levels assumed or, alternatively, the cost of all direct factory inputs would have to be reduced by not less than 50%.

1.10 FINANCIAL EVALUATION : OPTION B

1.10.1 The initial investment cost of Option B has been estimated at a total of P 632.5 million, equivalent to approximately US$ 24.33 million. 69% of this total would be payable in foreign currency :

Initial Fixed Investment Costs			
- Land	:	P	6,600
- Site Preparation	:	P	2,145
- Structures/Civil Works	:	P	116,841
- Incorporated Fixed Assets	:	P	856
- Machinery and Equipment	:	P	151,886
		P	278,328
Pre-Production Expenditures	:	P	225,102
Working Capital Requirement	:	P	129,090
Total	:	P	632,520

1.10.2 The financing arrangements proposed for Option B would result in an acceptable debt:equity ratio of 1.43:1 at project implementation, and are summarised as follows :

Equity Capital			
- Project Promoters	:	P	156,490
- Financial Agencies	:	P	104,326
Long-Term Borrowings			
- Foreign Currency	:	P	315,229
- Local Currency	:	P	56,475
Current Liabilities			
- at full capacity	:	P	19,521
Total	:	P	652,041

1.10.3 It has been assumed that the local project promoters would wish to retain an overall majority interest, consequently the participation of external financial institutions/agencies has been limited to 40%.

1.10.4 Expenditures on raw material inputs and utilities have been calculated by reference to clearly specified usage and cost figures per individual input, and provide the basis for estimating the unit cost of each of the products to be manufactured in terms of Option B. Comparison of these unit costs with the anticipated maximum selling prices highlights the fact that the project would produce both 6-APA and ampicillin at gross margins which would probably be unacceptably low :

per kg	Input Cost	Sales Price	Gross Margin	% Margin
6-APA	1,435	1,794	359	20%
Ampicillin	1,668	2,002	334	17%
Amoxycillin	1,698	2,340	642	27%
Coxacillin	1,619	2,860	1,241	43%

1.10.5 On the basis of the 15-year financial projections prepared, the feasibility of Option B would appear to be marginal at best :

a) The project would record a gross loss in each of the first five years of operation but, thereafter, the overall increase in the production of semi-synthetics in particular would result in a steady increase in pre-tax profitability. Net profits after tax would range from 9% to a maximum of 11.5%.

b) By the end of the 15-year period, accumulated profits would total nearly P 92.3 million and, given the reasonably strong positive cash flow as from the year 2000, total cash balances would exceed P 92 million.

c) The revenue and cash reserves would be such that 80% of profits after tax could be distributed as dividends as from 2007.

d) The internal rates of return in respect of total investment and equity capital, and their net present values, have been calculated as follows :

	Total Investment	Equity Capital
Internal Rate of Return	2.9%	1.7%
Net Present Value @ 19%	(P 342.9 mn)	(P 277.5 mn)
Net Present Value @ 15%	(P 313.0 mn)	(P 266.9 mn)
Pay-Back Period	13.5 years	

1.10.6 Two alternative scenarios were prepared to ascertain what changes would be necessary to enable the project to achieve an internal rate of return on total investment of 19%. These confirmed that sales prices would have to increase by a minimum of 31% over and above the levels assumed or, alternatively, the cost of all direct factory inputs would have to be reduced by not less than 50%.

1.11 FINANCIAL EVALUATION : OPTION C

1.11.1 The initial investment cost of Option C has been estimated at a total of P 1,462.9 million, equivalent to approximately US$ 56.3 million. 74% of this total would be payable in foreign currency :

Initial Fixed Investment Costs		
- Land	:	P 13,200
- Site Preparation	:	P 7,150
- Structures/Civil Works	:	P 395,946
- Incorporated Fixed Assets	:	P 55,876
- Machinery and Equipment	:	P 525,422
		P 997,594
Pre-Production Expenditures	:	P 360,873
Working Capital Requirement	:	P 104,400
Total	:	P 1,462,867

1.11.2 The financing arrangements proposed for Option C would result in an acceptable debt:equity ratio of 1.46:1 at project implementation, and are summarised as follows :

Equity Capital		
- Project Promoters	:	P 356,386
- Financial Agencies	:	P 237,590
Long-Term Borrowings		
- Foreign Currency	:	P 831,773
- Local Currency	:	P 37,118
Current Liabilities		
- at full capacity	:	P 22,074
Total	:	P 1,484,941

1.11.3 It has been assumed that the local project promoters would wish to retain an overall majority interest, consequently the participation of external financial institutions/agencies has been limited to 40%.

1.11.4 Expenditures on raw material inputs and utilities have been calculated by reference to clearly specified usage and cost figures per individual input, and provide the basis for estimating the unit cost of each of the products to be manufactured in terms of Option C. Comparison of these unit costs with the anticipated maximum selling prices highlights the fact that the project would produce both Pen-G feedgrade and 6-APA at a gross loss :

per kg	Input Cost	Sales Price	Gross Margin	% Margin
Pen-G (feedgrade)	905	650	(255)	(39%)
Pen-G (clinical)	905	1,300	395	30%
6-APA	1,916	1,794	(122)	(7%)

1.11.5 On the basis of the 5-year financial projections prepared, Option C would not appear to be a feasible proposition :

a) The project would record an operating loss in each year, due to the fact that the estimated input costs in respect of two out of three products exceed the selling prices assumed. Accumulated losses would exceed the equity capital by the third year of operation, at which point Option C would be technically bankrupt.

b) By the end of the 5-year period, the accumulated losses would total nearly P 1,191 million, and the cumulative cash shortfall would exceed P 1,238 million.

1.11.6 Two alternative scenarios were prepared to ascertain what changes would be necessary to enable the project to break-even after five years. These confirmed that sales prices would have to increase by a minimum of 75% over and above the levels assumed or, alternatively, the cost of all direct factory inputs would have to be reduced by not less than 62%.

1.12 CONCLUSIONS AND RECOMMENDATIONS

1.12.1 Three options were considered:

Option A is an integrated operation covering four stages. This would start with the fermentation of penicillium through 6-APA production, then semi-synthetic penicillins manufacture to the preparation of a range of products in final dosage form.

Option B would leave out the fermentation stage and using imported Penicillin G in bulk would proceed via 6-APA production, through semi-synthetic antibiotic manufacture to a range of products in final dosage form.

Option C would ignore the later stage of integrated manufacture and concentrate on the first two stages, producing and selling bulk penicillin G and 6-APA to other downstream manufacturers.

1.12.2 Based on the Market Survey, which also estimated the conservative market penetration for a new manufacturer, outline production facilities were designed to meet the proposed demands under the options considered. Manufacturing costs were estimated for each based on current availability and cost of chemicals and new process plant equipment, and other costs were assessed to produce all-in sales cost figures. Using current international prices for the various products envisaged in the three options, an economic evaluation of each option was made using the usually accepted criteria for project evaluations.

1.12.3 Using the tests applied in the project evaluations the results indicated that:

- Option A appeared to be economically doubtful
- Option B may be considered economically viable
- Option C was unlikely to be commercially viable

1.12.4 Using the alternative scenarios prepared during the financial evaluations to determine what changes could be made to enable the projects to break-even after five years, consideration has been given to the means to effect the changes. Two means are possible but cannot at this time be precisely quantified.

1.12.4.1 It is possible to reduce the capital cost of imported equipment by permitting the use of guaranteed secondhand equipment. Very considerable savings in capital expenditure can be made without sacrificing quality, performance or reliability. This is possible since reliable equipment can be acquired from large companies expanding their production plant by either increasing their equipment size or moving from batch production to continuous process, thus making the smaller equipment redundant and selling it at scrap value. Another input that could probably be reduced is the price of corn steep liquor. Given the right incentives the producers of 6% liquor could be induced to concentrate it to 50% and this could possibly be done using waste heat recovery from other processes, thereby reducing the cost of the 50% product from that calculated using international values for fuel oils.

1.12.4.2 Conservative estimates of market penetration have been used in the evaluations since this is prudent as a first measure in testing the viability of schemes. The market penetration of equally priced identical material achieved by different suppliers is a direct function of the sales effort and marketing techniques employed. It is not without credence that increased marketing activity over and above that allowed for in the costing in this report would result in substantially greater market penetration, at least in the Philippines. Export potential would depend on production facilities and output receiving the required certification for use in the importing countries. The establishment of an accredited certification administration would, therefore, be a priority for expansion into export markets was aimed for, and the cost of such an administration might justifiably be a government burden.

1.12.5 In considering the project to manufacture penicillins, non-economic considerations may be relevant. There are advantages and disadvantages to the Philippines in domestic manufacture and these are considered below for the three options.

1.12.5.1 For Option A the advantages are:

a) there is no indigenous manufacturer of penicillins and local manufacture would result in import substitution of Penicillin G and 6-APA

b) the forecast growth in demand for all penicillin products is rapid and exceeds the averaged growth for pharmaceuticals

c) there is a national strategic importance to the domestic self-sufficiency for health care requirements of penicillins

d) domestic manufacture from the basic materials onwards is in line with government policy objectives

e) the development of an indigenous source of penicillins provides an infrastructure for downstream compounding companies.

f) there is an opportunity for the Philippines to gain expertise in new biotechnical and pharmaceutical fields

g) locally produced materials could be used in the fermentation stages.

However there are disadvantages to domestic production in that by the proposed start date in 1995, there are uncertainties with respect to the size of local production capacity of bulk semi-synthetics in view of the proposed new plants by others which would effectively double existing capacity (eg Chemfields 100 t/a plans).

1.12.5.2 For Option B the advantages are:

a) import substitution of 6-APA would result since there are no indigenous manufacturers

b) there would be more limited impact of market fluctuations of Penicillin G over Option A

c) strategic self-sufficiency in penicillin derivatives would be maintained thus providing important health care requirements to the community from indigenous sources, since 6-APA is an internationally traded commodity and not likely to be permanently blocked from supply

d) a fall in Penicillin G prices internationally would be reflected in a drop in production cost of domestic 6-APA production

e) this option avoids the technically complex and risky fermentation step.

However, the disadvantage of having to rely on the price and availability of Penicillin G would mean that production of 6-APA and its derivatives would be subject to fluctuations in international price and availability, a disadvantage that could be mitigated by judicious forward buying and stockpiling.

1.12.5.3 For Option C the advantages are:

a) similar to those in Option A for the downstream activities

b) there would be developed in the Philippines, an infrastructure for existing compounding companies.

However, there would be little flexibility in manufacturing output which would be at the dictate of market fluctuations.

SECTION 2

PROJECT BACKGROUND AND HISTORY

2.1 PROJECT BACKGROUND

2.1.1 Manufacturing Process

Pen G Prod. → 6-APA Prod. → Semi Synthetics Prod. → Final Dosage Prod. → User Market

Semi-synthetic penicillins pass through several stages before they reach the consumer in final dosage form.

Stage 1 Penicillin G is produced by fermentation. The bulk of this production is used as a feedstock for the next stage, the production of 6-APA. However some can be converted immediately into final dosage forms of natural penicillin. The same plant and process can be used to manufacture Penicillin V.

Stage 2 The bulk of the Penicillin G is converted into 6-APA, the basic feedstock for a wide range of semi-synthetic penicillins. It has no direct use as a pharmaceutical. In addition, although not included within the terms of reference of this report, it is the starting material for the production of 7-ADCA. This is the base for part of the cephalosponin family of antibiotics.

Stage 3 Semi-synthetic penicillins are manufactured from 6-APA. The same process can be used to produce a wide range of bulk antibiotics but the main ones used in the Philippines are ampicillin, amoxycillin and cloxacillin.

Stage 4 The bulk chemicals (active ingredients) are then mixed with excipients and turned into final dosage forms by compounders. These final dosage forms can be capsules, tablets, syrups or liquid suspensions. Not all compounders have the equipment to manufacture all forms of dosage. Similarly, they do not restrict themselves to the production of semi-synthetic penicillins - their equipment is suitable for producing any pharmaceutical product.

Stage 5 The drugs then pass to the final user via the various distribution routes.

2.1.2 Manufacturing in the Philippines

At the time of this report, Stage 1 and Stage 2 of this production chain are not carried out in the Philippines.

Only one firm is engaged in Stage 3, Chemfields. This is a production facility owned jointly by the Philippines Government (60%) and United Laboratories (40%). It imports 6-APA in order to produce semi-synthetic penicillins in bulk. It does not produce any pharmaceuticals in final dosage form.

There are approximately 250 companies licensed to compound drugs (Stage 4) in the Philippines. Some of these companies are principals in that they market products under their own name, others are merely contractors.

2.1.3 Report Options

The terms of reference for the project (Appendix 1-1) require the examination of three options for the production of penicillins.

Option A is an integrated operation covering all four stages. This would start with the fermentation of penicillin and finish with a range of products in final dosage form.

Option B would leave out the first stage, fermentation, but would be an integrated operation based on the import of Penicillin G in bulk.

Option C would ignore the later stage of integrated manufacture and concentrate on the first two stages, selling its bulk products to other downstream manufacturers.

The three options are illustrated graphically below:-

Pen G Prod. → 6-APA Prod. → Semi-synthetic Prod. → Final Dosage Prod

	Pen G Prod.	6-APA Prod.	Semi-synthetic Prod.	Final Dosage Prod
Option A	✓	✓	✓	✓
Option B	—	✓	✓	✓
Option C	✓	✓	—	—

2.1.4 Saleable Products

At each stage of production a product is made which forms the essential raw material for the next production process. In addition, it can be sold direct. The products from each stage are as follows:-

Production Process	Feedstock Material	Saleable Product
Pen G Fermentation	Pen G for 6-APA production	Pen G (human use) Pen G (animal feeds) Pen V
6-APA Production	6-APA for bulk pharmaceutical production	6-APA for sale to other bulk producers eg Chemfields
Semi-Synthetics Production*	Bulk semi-synthetics for compounding in-house	Bulk semi-synthetics for use by other compounding plants
Final dosage forms*	-	Final dosage forms for sale to the end user

* Principally ampicillin, amoxycillin and cloxacillin.

Applying this to the three manufacturing options, the saleable products derived from each would be as follows:

<u>Option A</u> - Natural Penicillins
6-APA
Bulk semi-synthetics
Final dosage forms

<u>Option B</u> - 6-APA
Bulk semi-synthetics
Final dosage forms

<u>Option C</u> - Natural penicillin
6-APA

2.1.5 <u>Penicillin Production - Development</u>

Whilst the discovery of Penicillin was by Sir Alexander Flemming in England, the successful development of production methods was mainly completed in the USA during the period of the 2nd World War. Since that time, the product has been considered of vital strategic and therefore commercial importance, and the development of the commercial processes has generally been shrouded in secrecy. However, the initial method of producing Penicillin using deep stirred fermentation tanks, still survives today. Much of the detail of the process, especially the scale-up, is still regarded as a commercial secret and all details are not readily available or made known. It is for this reason that there are only a handful of pharmaceutical companies who have successfully developed the necessary know-how and successfully manufactured and sold antibiotics worldwide. In practice, these companies were from Western Europe or the USA and this pattern has largely remained unaltered throughout the succeeding years.

Regarding developing countries, since demand exceeds the supply in the former Soviet Union, China and in India, these countries all now manufacture their own Penicillin G. They do not however, all achieve the levels of productivity found in the best plants in developed countries, mainly due to the use of low productivity strains and lack of investment in process development.

2.1.6 Strategic Value

In many countries Penicillin G is considered to be strategically important and it is often subjected to special non-commercial "rules". Many developing countries therefore feel uncomfortable if supplies of Penicillin G are all imported, since there is a risk during periods of unrest or war that supplies could be interrupted, or become too expensive. Given these circumstances, Penicillin G does not always follow the normal market rules of supply and demand, and whilst it is true that capacity is now being reduced in Western countries, this is not true for the Asian region.

2.1.7 Feasibility Study Parameters

During the preparation of this feasibility study, the following major parameters were taken into consideration:-

- domestic and export market potential
- intended and anticipated future therapeutic use of the products
- prospects of developing a Philippine-based bulk pharmaceutical industry
- a location close to ports, University of the Philippines, raw materials and the existing distribution system.
- plant capacity based upon existing demand and forecasted future demand for the Philippines.
- maximum use of locally produced raw materials, especially cane sugar and corn steep liquor
- following the request of the Philippine Minister of Health, a projected timetable for the implementation of the project would only take place after a decision in 1992. Under these circumstances, the plant could start-up in 1995.

2.1.8 **Government Policy**

As described by the Ministry of Health, it is the policy of the Philippine Government that the project should comply with the following guidelines:-

- normally the Government would expect this project to become part of the private sector. Whilst there are some concessions designed to assist local companies manufacturing products which compete with imports, the Government would ideally wish this project to stand on its own feet; in other words, become commercially viable.

- from an industrial point of view, the antibiotics plant, if implemented, would represent the first large-scale bulk pharmaceutical plant within the region. Naturally, the Government hopes that such an investment would encourage other similar types of investment.

- while the main objective is to cater for the domestic demand, extra benefits could be obtained by selling the products into other ASEAN countries, as well as further afield, for example in Korea and Taiwan.

- at the present time almost all the products are imported from ingredients and raw materials, some of which are probably only made in less than twenty factories worldwide.

- although it is the Philippine Government policy to encourage private investment into the project, it is not ruled out that the project might remain in the public sector.

To summarise, the Philippine Ministry of Health wishes to promote the local manufacture of pharmaceutical products and antibiotics have been selected as the first choice for bulk manufacture. From the Ministry's standpoint, the two important questions which require to be addressed are simply the technical and the financial viability of the project.

Following this feasibility study, it is expected that the Ministry will have sufficient evidence to assist them in forming their future policy.

2.2 PROJECT INITIATOR

The initiator of this project, together with previous UNIDO studies, is the Ministry of Health in the Philippine Government, whose address is:-

San Lazaro Compound, Rizal Avenue, Santa Cruz, Manila, Philippines, telephone 711-6771/711-6105

2.3 PROJECT HISTORY

2.3.1 The United Nations Industrial Development Organisation (UNIDO) has for some years co-operated with the Ministry of Health in the Philippines towards identifying and establishing a locally based pharmaceutical industry.

2.3.2 Working in close conjunction with the Philippines Government, UNIDO has produced previous studies of the pharmaceutical industry in the Philippines with the objective of pinpointing the areas most likely to yield successful results.

2.3.3 Previous studies and investigations include the following:-

- "Assessment of the agricultural raw materials for drug preparation in the Philippines" (W Padolina, UNIDO, 14 September 1988)
- "Assessment of Research and Development in Biotechnology and Biochemistry in relation to development of Pharmaceutical Industry in the Philippines" (W Padolina, UNIDO, 19 September 1988)
- "Medicinal Plants and Essential Oils - Philippine experience" (W Padolina, UNIDO 19 September 1988)
- "State of Science and Technology in the Philippines" (W Padolina, UNIDO, 5 October 1988)
- "Fermentation Processes, Manpower Training, Suggestions for new Biotechnology in the Philippines" (H Bungay, 19 December 1988)
- "Semi-synthesis of Antibiotics" (R Sciaky, UNIDO, 16 February 1989)
- "Environment and Possibility of Pharmaceutical Industry in Philippines and Upstream Integration" (K Ivanov et al, UNIDO, 9 March 1989)
- "Manufacture of Antibiotics through Fermentation" (V Gallo, UNIDO, 17 April 1989)

2.3.4 The above studies identified that the bulk production of Penicillin G, 6-APA and semi-synthetic penicillins were the most likely prospects for the successful development of a new, locally based bulk pharmaceutical industry. The terms of reference of the present study have been drafted after consideration of conclusions and recommendations made previously.

2.3.5 MANDERSTAM CONSULTING SERVICES

The present study has been completed for UNIDO on behalf of the Philippine Ministry of Health by Manderstam Consulting Services of London.

SECTION 3

MARKET AND PLANT CAPACITY

3.1 BACKGROUND

3.1.1 Specification, Selection and Use of Products

3.1.1.1 The products which are the subject of this report are limited to the natural penicillins, Pen-G and Pen-V, and three semi-synthetic penicillins, namely, Ampicillin, Amoxycillin and Cloxacillin. The demand for various other semi-synthetic penicillins is also examined, but the volumes identified are too low for economic production. (See Appendix 3-4).

3.1.1.2 The intermediate chemical 6-APA is required as the basic feedstock for the manufacture of semi-synthetic penicillins. 6-APA is produced from natural penicillin as a feedstock, and has no direct pharmaceutical use.

3.1.1.3 In common with industry practice, this report restricts the term "pharmaceutical" to chemicals in their final dosage forms. All other products, including bulk supplies of ampicillin, amoxycillin and cloxacillin, are described as "fine chemicals".

3.1.1.4 The five pharmaceuticals with which this report is concerned are used as broad spectrum antibiotics to treat a wide range of diseases and infections, particularly those of the respiratory tract and ear, as well as some sexually transmitted infections. Full details are set out in Appendix 3-1.

3.1.2 World Market for Antibiotics

3.1.2.1 According to the World Health Organisation, the production and sale of pharmaceuticals is a major world industry, valued at approximately US$ 100 billion per year.

3.1.2.2 Both the WHO and commercial research companies confirm that the pharmaceutical industry has shown steady and high growth in real terms over the last decade. Most of this growth has come from high-value drugs protected by patent, but generic drugs have become increasingly important in recent years.

3.1.2.3 Generic drugs are pharmaceuticals which have come off patent as a result of time expiry, or which have never been patented. The output of the generic drug industry is sold world-wide, but its principal impact has been in developing countries seeking cheaper alternatives to branded drugs.

3.1.2.4 Although per capita expenditure on pharmaceuticals is much lower in developing countries than in the industrialised nations, the requirement for basic drugs is much higher in the former.

3.1.2.5 Appendix 3-2 details the major trends in the world market for pharmaceuticals which could have an influence on the Philippines.

3.1.3 <u>World Market for Antibiotics</u>

3.1.3.1 The pharmaceuticals which are the subject of this report are all classed as antibiotics. Natural and semi-synthetic penicillins comprise the largest single group of antibiotics and, according to industry surveys, they have also registered the fastest rate of growth.

3.1.3.2 The relatively high demand for antibiotics in the developing world reflects the health profile of these countries. The underlying problems of malnutrition, poor sanitation and poverty which generally prevail in developing countries result in the rapid spread of infection. In the majority of cases, the most appropriate treatment is provided by antibiotics, and by broad-spectrum penicillins in particular.

3.1.3.3 Industry estimates show that, between 1985 and 1990, usage of antibiotics in North America and Europe grew by 4% per annum, as compared with an average rate of 8% per annum in the developing world.

3.1.3.4 For a more detailed analysis of world usage of antibiotics and their relative growth rates, please refer to Appendix 3-3.

3.1.4 <u>Antibiotics in the Philippines</u>

3.1.4.1 Penicillins account for just over one third of all antibiotics used in the developing world and, in the Philippines, their relative importance is even more marked. According to private sector surveys carried out by IMS Pacific, a market research agency based in Manila, penicillins account for 36% of the demand for antibiotics by volume, and for 44% by value.

3.1.4.2 In addition penicillins also comprise a major element of government expenditure for the rural health units (RHUs), and are the main pharmaceutical additive to animal feeds. In total, therefore, penicillins account for over 50% of the demand for antibiotics in the Philippines.

3.1.4.3 Ampicillin and amoxycillin are the most important penicillins in use, respectively accounting for 32% and 30% of total demand by value. The natural penicillins, Pen-G and Pen-V, together account for about 14% of demand, followed by cloxacillin with an 8% share of the market. No other semi-synthetic penicillin represents more than 5% of demand.

3.1.4.4 Although there are a further fifteen semi-synthetic penicillins in use in the Philippines, these are primarily used for specialist purposes, and together account for less than 15% of total demand. Given that such low volumes could not be economically produced by the proposed plant, they have not been taken into consideration at this stage.

3.1.4.5 Further details of the penicillins in use in the Philippines are presented at Appendix 3-4.

3.2 DATA AND ALTERNATIVE PROJECTION METHODS

3.2.1 Data Required for the Market Study

3.2.1.1 **Sources of Data**

The basic data sources in the Philippines varied considerably in terms of the quality, reliability and comprehensiveness of the statistics available. As a result, as many sources of information as possible have been brought in and every effort has been made to reconcile the inconsistencies and discrepancies identified.

3.2.1.2 **Domestic Production**

The only producer of semi-synthetic penicillins in the Philippines is Chemfields, a company owned jointly by the Philippines Government (60%) and by United Laboratories (40%). Although Chemfields fully cooperated in the preparation of this study in general terms, management was reluctant to reveal detailed production and sales information on the grounds of commercial confidentiality. However, the following estimate of production and sales in 1990 was deduced by cross-checking data obtained from a number of alternative sources (specified in Appendix 3-5) :

	Production	Sales
Ampicillin	46 tonnes	47 tonnes
Amoxycillin	44 tonnes	32 tonnes
Cloxacillin	12 tonnes	8 tonnes
Total	102 tonnes	87 tonnes

3.2.1.3 **Import Statistics**

The import statistics published by the Department of Customs proved to be too general to be of use, and the original documentation was unfortunately not accessible to us. As an alternative, we therefore used the contemporaneous monthly import statistics prepared by a private company, Business Statistics Monitor (BSM). Given the possibility of human error in the preparation of these statistics, the BSM data for May 1991 were cross-checked against the original customs documents. This confirmed that the standard of accuracy is sufficiently high for this source to be regarded as reliable :

Imports of Pharmaceuticals : 1987 - 1990

tonnes	1987	1988	1989	1990	Average
Pen-G	17.7	11.2	17.3	20.9	16.8
Pen-V	27.0	19.5	17.9	20.7	21.3
Ampicillin	1.6	0.4	3.8	1.7	1.9
Amoxycillin	1.8	6.3	8.3	20.2	9.1
Cloxacillin	4.9	*	*	*	1.2
Total	53.0	37.4	47.3	63.5	50.3

* negligible

As a result of Executive Order 776 of 24 February 1982, the Bureau of Food and Drugs (BFAD) instructed all importers to apply for permission to import antibiotics. These applications should correspond to the import statistics, except where importation did not go ahead, and a series of random checks was accordingly carried out to compare them with the BSM records. This confirmed that the two sources gave similar results, so lending further credibility to the accuracy of the BSM import data.

Finally, it is widely acknowledged that a proportion of all pharmaceutical imports are brought in by illegal means. Given that the extent of this trade cannot be quantified with any accuracy, an allowance of 5% of the identified market should be included in the analysis to cover imports which are not recorded by Customs. However, this figure has been increased to 15% in the case of amoxycillin, in view of the rapid increase in demand in recent years, and the large number of "one-off" contracts being awarded for its supply.

Further details on the import statistics obtained are presented in Appendix 3-5, together with a short commentary on the trends identified.

3.2.1.4 **Private Sector Demand Statistics**

The private sector currently accounts for about 85% of demand for pharmaceuticals. According to data collated by IMS Pacific, a private research agency which specialises in pharmaceutical statistics, the demand for ampicillin and amoxycillin in pharmacies and hospitals in 1990 was as follows :

Private Sector Demand for Semi-Synthetics : 1990

tonnes	Pharmacies	Hospitals	Total
Ampicillin	21.32	2.54	23.86
Amoxycillin	15.83	2.33	18.16

Source : IMS Pacific

United Laboratories, the largest manufacturer of pharmaceuticals in the Philippines, have compiled their own estimates of market demand for planning purposes. These have a wider scope than the IMS figures, but still omit significant sectors of the industry :

Estimated Private Sector Demand : 1990

Penicillin-G	50 tonnes
Penicillin-V	35 tonnes
Ampicillin	60 tonnes
Amoxycillin	49 tonnes

Source : United Laboratories

Unfortunately, these figures are not compatible and the discrepancies are such that little reliance can be placed on either set of estimates. However, additional information on both sources is given in Appendix 3-6.

3.2.1.5 **Public Sector Demand Statistics**

With regard to the public sector, a multiplicity of purchasing agencies were identified, both within the Department of Health and in other government bodies. The majority of these agencies do not maintain detailed purchase records, particularly in terms of quantities, the only common factor being the budget amount allocated to expenditure on drugs. However, most purchases are small, and they are usually made through the private sector.

In order to avoid double-counting, we concentrated on the two largest areas of public demand : namely, purchases for the Rural Health Units (RHUs) and public hospital usage. The quantities identified are detailed in Appendix 3-6 but, unfortunately, the overall picture gained was not precise enough to form the basis of a public sector demand model.

3.2.1.6 **Historic Trend Data**

Historic data on domestic production of bulk semi-synthetics and on imports of pharmaceuticals over four years are set out in Appendix 3-5. A longer time-series showing the growth in demand over a 10-year period was obtained from IMS Pacific. This is presented at Appendix 3-7, together with the results of independent research carried out by United Laboratories over the last five years.

3.2.1.7 **Population Projections**

The population projections have been based on the provisional figures released for the 1990 census. No official forecasts have yet been prepared by the Statistics Office, but government demographers predict that the rate of growth will decline from 2.25% per year to 1.9% per year over the next 15 years (Appendix 3-8 refers).

3.2.1.8 **Health Profile**

The detailed morbidity and mortality statistics which are maintained by the Department of Health confirm that these are dominated by communicable diseases, the majority of which can be treated by broad-spectrum penicillins. This is further discussed in Appendix 3-8, as are the underlying problems of overcrowding, malnutrition and poor hygiene conditions.

3.2.1.9 **Economic Forecasts**

Social Trends published by the National Statistics Office indicate that the proportion of family income spent on health care will rise slowly over the next decade. Government expenditure on rural health care and drugs is also likely to be at least maintained in real terms, or slightly increased over the same period.

3.2.1.10 **Evaluation of Sources**

Appendix 3-9 evaluates the individual sources of data used, and the level of confidence with which each is viewed is summarised in the following table :

Appendix 3-5 : Supply Statistics

BFAD	: Chemfields Production	: Medium
BSM	: Import Statistics	: High
BFAD	: Import Applications	: Medium
Various	: Unrecorded Imports	: Low

Appendix 3-6 : Demand Statistics

IMS Pacific	: Private Sector Demand	: Low
United Laboratories	: Private Sector Demand	: Low
Dept. of Health	: RHU Purchases	: High
Hospital Survey	: Hospital Purchases	: Medium

Appendix 3-7 : Historic Growth Rates

IMS Pacific	: Market Growth Rates	: High
United Laboratories	: Market Growth Rates	: High

Appendix 3-8 : Future Demand Trends

Nat. Stats. Office	: Population Estimates	: High
Nat. Stats. Office	: Population Trends	: Medium
Dept. Of Health	: Mortality/Morbidity	: Medium
Nat. Stats. Office	: Economic Forecasts	: Medium
Nat. Stats. Office	: Family Expenditure	: High

3.2.2 <u>Alternative Methods of Data Evaluation</u>

3.2.2.1 **Current Market Demand**

Given the complexity and geographical diversity of the market in the Philippines, combined with fact that decision-making in both the private and public sectors is decentralised, it was inappropriate to undertake a survey of public and private pharmacies and doctors. Such a survey would require a very large investment in terms of both manpower and time. The improved accuracy over current sampling techniques would not justify such a massive investment.

However, information on unrecorded imports, hospital purchases and retail prices was independently surveyed to supplement existing data sources and thereby to ensure complete coverage.

A more sophisticated method of assessment would be to assign weights to all collected data according to the level of confidence in that data. The major drawback of this method is that it inevitably involves the use of subjective value judgements.

3.2.2.2 **Projected Market Demand**

Although historic growth trends are useful in that they establish parameters, a straightforward projection of past trends can be seriously misleading and care should be taken not to use these in isolation.

International comparison can be a useful tool in making projections, particularly when the country concerned has a similar social/economic environment and pattern of development. However, such an approach also tends to be of essentially academic value, in that there are too many variables involved to allow simple comparisons to be made.

The most effective method for projecting future trends is to construct a mathematical model to incorporate data on all relevant influences on market size and demand. Such a model could then be tested against historic growth patterns, but its accuracy would depend not only upon the quality of the base data used, but also on the number of market influences incorporated.

3.2.2.3 **Method Chosen for Data Evaluation**

On balance, the demand figures obtained were considered to be neither sufficiently comprehensive nor precise enough to provide a reliable basis for estimating the size and development potential of the market. We have therefore concentrated our analysis of market size on the supply data.

A number of alternative models were constructed to establish demand projections over the next fifteen years, but their accuracy was called into question on two counts : the limitations of the social and economic data available, and the number of variables affecting drug consumption. The relatively simple model chosen has therefore been based on population growth plus a weighted average of three other key elements : namely, the prospects for the economy, the pattern of family expenditure, and a shift in prescription patterns to reflect the changing health profile of the population. Details are given in Appendix 3-10.

3.3 DETERMINATION OF DEMAND AND MARKET SIZE

3.3.1 Final Dosage Forms

3.3.1.1 Market demand for the selected forms of natural and semi-synthetic penicillins, expressed in terms of the weight of active ingredients, has been calculated at a total of approximately 163 tonnes in 1990. The three semi-synthetic products comprise 73% of this figure :

Market for Selected Pharmaceuticals : 1990

tonnes	Domestic Production	Imports	Unrecorded Imports	Total Demand
Natural Penicillins				
Pen-G	-	19	1	20
Pen-V	-	23	1	24
Semi-Synthetics				
Ampicillin	47	2	2	51
Amoxycillin	32	20	8	60
Cloxacillin	8	-	-	8
	87	64	12	163

Sources : Domestic production has been based on our estimates of Chemfields sales.

Imports are generally based on the 1990 figures reported by BSM, but modified to allow for such factors as bunched shipments.

Provision has been made for illegal or unrecorded imports, calculated at 5% of the identified market for Pen-G, Pen-V and ampicillin, and 15% of that for amoxycillin.

3.3.1.2 The combined market for Pen-G and Pen-V can be broken down further into the various forms used :

Market for Natural Penicillins : 1990

	Tonnes	Percentage
Pen-G Potassium	6.6	15%
Pen-G Sodium	2.6	6%
Pen-G Procaine (sterile)	2.2	5%
Pen-G Procaine (feedgrade)	7.5	17%
Pen-V	24.2	55%
Other Forms	0.9	2%
Total	44.0	

3.3.1.3 Demand for the different dosage forms in use does vary from year to year, particularly as a result of large government tenders. However, analysis of the market over a period of three years indicates the following split, which we believe to be a reliable guide :

	Natural Penicillins	Ampicillin	Amoxycillin Cloxacillin
Tablets/Capsules	-	70%	70%
Liquids/Syrups	-	5%	20%
Drops	-	5%	5%
Vials	100%	20%	5%

3.3.2 **Derived Demand for Semi-Synthetics**

3.3.2.1 Given that the market for final dosage forms has been calculated in terms of the active ingredient only, the above figures also give us the derived demand for the bulk semi-synthetic product :

Market for Semi-Synthetic Bulk Product : 1990

	Tonnes
Ampicillin	51
Amoxycillin	60
Cloxacillin	8
Total	119

3.3.3 **Derived Demand for 6-APA**

3.3.3.1 The amount of 6-APA needed to produce this quantity of semi-synthetic product may be calculated by reference to the fixed relationships in the chemical process :

	Semi-Synthetic		Conversion Factor		6-APA
Ampicillin	51 tonnes	x	0.648	=	33.0 tonnes
Amoxycillin	60 tonnes	x	0.643	=	38.6 tonnes
Cloxacillin	8 tonnes	x	0.567	=	4.5 tonnes
Total	119 tonnes			=	76.1 tonnes

3.3.3.2 In addition, provision must be made for the future supply of 6-APA to the export production facilities which are to be established in the Philippines. This is covered in detail in Section 3.5.1.4.

3.3.4 <u>Derived Demand for Natural Penicillins</u>

3.3.4.1 The amount of natural penicillin needed to produce this quantity of 6-APA may also be calculated by reference to the fixed relationship in the chemical process :

	6-APA		Conversion Factor		Natural Penicillins
Semi-Synthetics	76 tonnes	x	1.85	=	140 tonnes

3.3.4.2 Given the identified demand for 44 tonnes of Pen-G and Pen-V, the total requirement for natural penicillins for both end-use and as a basic raw materials feedstock thus amounted to 184 tonnes in 1990.

3.4 <u>EVALUATION OF DATA RESULTS</u>

3.4.1 <u>Size and Composition of Demand</u>

3.4.1.1 Although government purchases vary substantially from year to year as a result of the RHUs in particular, it is estimated that private sector demand accounts for 80% to 85% of drug purchases as a whole. However, the pattern of individual demand is not consistent :

	Private Sector		Public Sector	
	tonnes	%	tonnes	%
Pen-G	19.0	95%	1.0	5%
Pen-V	21.0	87%	3.0	13%
Ampicillin	49.6	97%	1.4	3%
Amoxycillin	33.0	55%	27.0	45%
Cloxacillin	6.3	79%	1.7	21%
Total	128.9	79%	34.1	21%

3.4.1.2 One of the apparent anomalies may be explained by the fact that almost 40% of the Pen-G used by the private sector is destined for the production of animal feeds. In addition, ampicillin is not an approved drug, in that it is not listed in the Philippines National Drug Formulary, hence its limited use by the public sector. This is further reflected in the correspondingly higher usage of amoxycillin.

3.4.1.3 The above figures also understate the actual demand for antibiotics, to the extent that demand is suppressed by a lack of resources in both the private and public sectors.

3.4.1.4 The Department of Health has estimated this unrealised demand at between 150% and 200% of current usage. Our own estimate, based on discussions with doctors and pharmacologists, is that the use of these antibiotics would have to be tripled in order to bring the population of the Philippines to an adequate level of health-care.

3.4.2 **Demand Projections**

3.4.2.1 The figures detailed in Appendix 3-7 show that, in real value terms, the total drug market expanded by just under 5% per year during the last decade, and at 5.5% p.a. over the last five years. This is more than double the average rate of population growth of 2.36% per year for the same period.

3.4.2.2 Broad spectrum penicillins have grown at above average rates over the period as a whole, despite the fact that their prices have not increased as rapidly as those for the newer, patented drugs. In particular, government purchases have been increasing at an annual average of about 10% in real terms.

3.4.2.3 Continued population growth will be the main factor in determining demand for these antibiotics, followed by the priority which is being given to expenditure on health care and drugs (Appendix 3-8 refers). However, the relative growth of each product will vary :

a) The natural penicillins are likely to grow more slowly than average, primarily because they are regarded as being less effective than the semi-synthetics. Pen-V is also less versatile than Pen-G, and its use will decline in real terms.

b) Given that **Ampicillin** is not listed in the PNDF, it is also likely to decline in absolute terms. This decline will accelerate with the government education programme, and as public awareness of more effective alternative products increases.

c) **Amoxycillin** will grow strongly, both as a drug in its own right and as a substitute for ampicillin, although this growth will not be as strong as in the recent past.

d) **Cloxacillin** is a more specialist product, use of which is expected to increase significantly.

3.4.2.4 In addition, the production of pharmaceuticals is a high technology field where major changes can take place in a relatively short time, and new drugs could be developed to replace the products selected. As most semi-synthetics are produced by similar processes, it is anticipated that the production facility would be flexible enough to accommodate such changes.

3.4.2.5 Based on the growth factors identified, demand for the products in question is expected to increase at the following annual percentage rates :

	1991-1995	1996-2000	2001-2010
Pen-G (feedgrade)	3.25%	3.1%	2.9%
Pen-G (human)	5.25%	4.1%	3.9%
Pen-V	0.75%	- 0.9%	- 3.1%
Ampicillin	1.75%	- 2.9%	- 3.1%
Amoxycillin	12.25%	7.1%	4.9%
Cloxacillin	9.25%	9.1%	7.9%

3.4.2.6 Further details as to how these annual percentages have been calculated are set out in Appendix 3-10, as is the full breakdown of the market projection obtained by applying them to our estimate of total domestic demand in 1990 (section 3.3.1.1 refers) :

Forecast Future Demand for Penicillins

Tonnes	1990	1995	2000	2005	2010
Pen-G (feedgrade)	8	9	11	13	15
Pen-G (human)	12	15	19	23	28
Pen-V	24	25	24	20	17
Ampicillin	51	47	40	34	29
Amoxycillin	60	107	151	191	242
Cloxacillin	8	12	19	28	41

3.4.3 Maximum Potential Market and Market Penetration

3.4.3.1 **Natural Penicillins**
The fermentation plant would be able to produce both the Pen-G and Pen-V required by the end-user market with very little extra processing. It would then have the option of either selling these in bulk to current importers, or packaging them into final dosage forms and competing with established marketing companies.

a) **Feedgrade Pen-G** is easy to manufacture and the limited number of feed producers which already import Pen-G comprise a readily identifiable market for the bulk product.

b) The new facility would have the option of supplying **human grade penicillins** either in bulk or in final dosage form. However, we recommend that it should concentrate on supplying other users with bulk product, as opposed to entering into competition with its own customers in the production of final dosage forms.

Based on the experience of Chemfields, it is our belief that, subject to the quality and price of the product being acceptable, the proposed plant should be able to supply identified private sector demand, as reflected in the 1990 figures. Thereafter, in order to provide for uncertainty in the future growth in demand, as well as for competition from continued imports, the maximum potential markets for both feedgrade Pen-G and human grade penicillins have been forecast at a level which is equivalent to the total market in 1990, plus 50% of all subsequent increases.

However, in recognition of the fact that actual sales are unlikely to reach their potential levels until the production facility is well established, it has been further assumed that it would take the project five years to achieve these target levels :

Natural Penicillins *

	Forecast Demand	Target Sales	Actual Sales	% Market Penetration
1995	49	47	9	18%
1996	51	48	19	37%
1997	51	48	28	55%
1998	51	48	38	75%
1999	53	49	49	92%
2000	54	49	49	91%
2005	56	50	50	89%
2010	60	52	52	87%

* For a detailed breakdown of the above figures, please refer to Appendix 3-11.

3.4.3.2 6-APA

The market for 6-APA is more limited than for natural penicillins. At the present time, Chemfields is the sole purchaser of 6-APA in bulk form but, by 1995, we anticipate that the two additional plants which have been approved (HD Pharma and First Pharmaceutical) would each have substantial requirements.

As both a supplier of 6-APA and a producer of semi-synthetics, the proposed project would be competing in the market for the latter with its potential customers for 6-APA. Such cross-purchasing is not uncommon in the chemical industry, although it is not desirable.

As with the natural penicillins, the maximum potential market for 6-APA has been forecast at a level which is equivalent to identified demand in 1990, plus 50% of all subsequent increases. This makes due provision not only for uncertainties in the future growth of demand, but also the probability that customers would not wish to be completely dependent upon one supplier for their chief raw material.

However, given that 6-APA is effectively the "buffer" product, its availability for sale to third parties is determined by the surplus of production over in-house requirements for further processing. For example, on the basis of the overall production levels assumed for Option A, actual sales have been projected to increase as follows :

6-APA ; Option A *

	Forecast Demand	Target Sales	Actual Sales	% Market Penetration
1995	155	115	54	35%
1996	163	119	85	52%
1997	172	124	101	59%
1998	181	129	90	50%
1999	192	134	80	42%
2000	202	139	98	49%
2005	248	162	114	46%
2010	308	192	107	35%

* The actual sales levels projected for Options B and C are set out in Appendix 3-11.

3.4.3.3 **Bulk Semi-Synthetics**

There are about a dozen regular importers of bulk pharmaceuticals, primarily for government contracts, and Chemfields has a further fourteen or so established customers. The market thus comprises a total of about 25 companies, many of whom have traditionally imported their supplies.

With implementation of the proposed HD Pharma and First Pharmaceutical projects, there should also be three well-established domestic producers of semi-synthetic penicillins serving the market by 1995.

In the face of such strong competition, the proposed new plant would have to fight for a share of the market for bulk semi-synthetic penicillins. However, subject to effective marketing, and with due provision for a gradual build-up in sales, it should be able to achieve its target market penetration of 25% within a period of five years :

Bulk Semi-Synthetic Penicillins *

	Forecast Demand	Target Sales	Actual Sales	% Market Penetration
1995	166	42	17	10%
1996	174	44	26	15%
1997	182	46	35	19%
1998	190	48	44	23%
1999	201	50	50	25%
2000	210	53	53	25%
2005	253	63	63	25%
2010	312	78	78	25%

* For a detailed breakdown of the above figures, please refer to Appendix 3-11.

3.4.3.4 Final Dosage Semi-Synthetics

The market for ampicillin, amoxycillin and cloxacillin in final dosage form is fiercely competitive and is dominated by established brand names.

Appendix 3-12 lists the 50 or so brands of ampicillin and amoxycillin available in the Philippines in 1990. In the case of ampicillin, the leading four brands account for 33% of the total market, whereas in that of amoxycillin, only three brands account for 20% of the market. The balance of demand is supplied by a large number of lesser known brand names, the majority of which have less than a 1% share of the total market.

In these circumstances, we consider that the project would be unable to secure more than a 2% share of the market for final dosage products. Even this would take five years to achieve, and would also necessitate heavy expenditure on marketing and product promotion :

Final Dosage Semi-Synthetics *

	Forecast Demand	Target Sales	Actual Sales	% Market Penetration
1995	166	3.3	0.8	0.5%
1996	174	3.5	1.7	1%
1997	182	3.6	2.4	1.3%
1998	190	3.8	3.2	1.7%
1999	201	4.0	4.0	2%
2000	210	4.2	4.2	2%
2005	253	5.1	5.1	2%
2010	312	6.2	6.2	2%

* For a detailed breakdown of the above figures, please refer to Appendix 3-11.

3.5 ADDITIONAL DATA REQUIRED AND ALTERNATIVE STRATEGIES

3.5.1 Additional Data

3.5.1.1 Government Policy

The government has consistently had to compromise in its industrial policy by affording some protection to new high technology industry within the context of a free market economy. Chemfields is a case in point, and all imports of semi-synthetic antibiotics have been subject to control since 1982 (Appendix 3-13 refers). In effect, imports have only been permitted if they were at least 20% cheaper than the Chemfields product.

This legislation should have benefitted the country, in that it allowed Chemfields a degree of protection without insulating it completely from international competition. However, as a member of GATT, the Philippines is supporting the gradual move towards rationalisation of trading links by the elimination of non-tariff barriers. It is therefore unlikely that protection of the type granted to Chemfields would be extended to the proposed new facility.

In the field of health care, current efforts to improve living conditions and health care facilities for the poorer sections of the population are likely to remain government priorities.

The National Drug Policy also commits the government to support an indigenous drug manufacturing industry, whilst the Control of Communicable Diseases Programme sets specific targets for the Department of Health. These, by implication, assume a continued demand for antibiotics.

3.5.1.2 Tariff Policy

Current tariff policy in the Philippines is detailed in Appendix 3-14.

With regard to future rates of duty, likely scenarios for each of the various manufacturing options have been drawn up, based on our discussions with government officials. These are presented in Appendix 3-15 and, whilst there can be no guarantees, we believe that the following tariff rates could be negotiated :

	Current Rate	Option A	Option B	Option C
Penicillin Culture	10%	3%	10%	3%
Pen-G Bulk	10%	20%	3%	20%
6-APA	3%	20%	20%	20%
Bulk Semi-Synthetics	10%	30%	30%	*
Final Dosage Forms	20%	30%	30%	*

* not applicable

3.5.1.3 **Export Potential**

Consideration of the market should not be limited to the domestic economy, but needs to examine the possibilities for developing exports.

At first sight, the world markets for 6-APA and semi-synthetic penicillins in bulk form appear attractive, as there are only a limited number of potential users. However, integrated multinational manufacturers account for approximately 75% of the world demand for bulk products. Most of the market is therefore effectively closed to an independent producer.

In the last five years, production units have been established in the old Soviet Bloc and such developing countries as India and China to take advantage of the opportunities created when products come off patent. Although this should expand the potential market, it has also increased competition in the short term and will inevitably accentuate the steady downward trend in 6-APA prices.

Dealing in bulk products as a commodity requires a flexible approach, combined with an extensive network of trading contacts. In addition, any participant in the market must have credibility as an experienced and reliable producer. Any newcomer to the market would have to develop this reputation over a period of years.

The market for products in final dosage form is far more widespread than that for bulk chemicals. Demand throughout the developing world is increasing at approximately 6%, as compared with an annual average of 3% in the developed nations.

However, most countries require pharmaceutical imports to originate from factories which are certified by, for example the U.S. Food and Drug Administration. Many developing nations are also trying to encourage local production of pharmaceuticals, owing to their perceived strategic value. A further problem arises from the fact that international drug companies are often able to undercut independent producers by taking advantage of relative economies of scale.

Our assessment of the export potential in the countries which neighbour the Philippines is set out in Appendix 3-16. Indonesia, Thailand and Malaya are identified as target markets but, in practice, political factors far outweigh economic considerations in developing such trade. Any export drive would thus have to be preceded by a political initiative on a bilateral basis to ensure its success.

3.5.1.4 **Indirect Export Potential**

The Board of Investment has given permission for two new plants to be built for the production of bulk amoxycillin from 6-APA. Appendix 3-17 details such information as is currently available on these two projects.

Both of the companies involved, HD Pharma and First Pharmaceutical, have close links with South Korea, and have agreed that a substantial proportion of their production will be exported.

It is anticipated that, by 1995, these two new plants would together require sufficient 6-APA to produce 75 tonnes of bulk amoxycillin for export, over and above their needs for the domestic market. This translates into just over 48 tonnes of 6-APA.

3.5.1.5 **Alternative Export Strategies**

We are of the opinion that, at the outset, the plant should be planned and costed for supplying the domestic market only :

a) The bulk chemical market is limited in size, owing to the internationl participation of the multinationals. It is also very competitive and, in the short-term at least, there is considerable over-capacity.

b) The market for final dosage forms is large and growing rapidly, but political considerations play a role in the trade policies of many developing nations. In addition, it is very important for manufacturers to first establish a reputation for high quality production and to gain the approval of some recognised authority (such as the USFDA).

However, consideration should be given to developing direct exports in the longer term, once the plant has established a track record with regard to production and sales, and has completed all the necessary groundwork in political as well as commercial terms.

In the meantime, an alternative export strategy would be to further develop the technical and commercial links of international companies such as United Laboratories. Every effort should be made to ensure that HD Pharma and First Pharmaceutical obtain the raw materials required for their export production from the new plant.

3.5.1.6 **Structure of the Market**

The market for all drugs in the Philippines is worth between 13 billion and 16 billion Pesos when valued at retail prices. Most expert opinion inclines towards the upper estimate.

Private sector purchases account for 90% of this total, with government purchases making up the balance :

Drugstores	:	78%	
Private Hospitals	:	9%	
Dispensing MDs	:	3%	
Private Sector Total	:		90%
Government Hospitals	:	6%	
Government Agencies	:	4%	
Public Sector Total	:		10%
Overall Total	:		100%

The main supply channels used to distribute drugs throughout the Philippines fall into three separate categories :

	Private Sector	Public Sector
Level 1 **Brand Owners**	Marketing Companies Importers	
Level 2 **Distributors**	In-house Distribution Wholesalers	Dept. of Health
Level 3 **Retailers**	Retail Pharmacies Dispensing Doctors Private Hospitals	Government Agencies Rural Health Units Public Hospitals

Each of these levels is discussed in more detail in Appendix 3-18. However, a key point to note is that, at each level, it is a Philippines-based company which dominates the sector :

a) United Laboratories is the largest **manufacturer** of pharmaceuticals, with a 20% market share. It does not operate as a single company but has a number of subsidiaries, each of which operates under a different name. This "fragmentation" is highlighted in Appendix 3-19, which lists the 100 largest companies in order of size, and identifies both the Unilab and the other Filipino-owned companies. The main rivals to Unilab are the multinational firms selling patented drugs. None of these can match the range covered by Unilab, and none has more than a 5% share of the market.

b) Of the **wholesale distributors**, Zuellig controls an estimated 40% to 45% of the total market. It has expanded significantly in recent years as a number of multinationals have given up in-house distribution and concentrated on marketing. The only other competitors of note are Marsman and Metro.

c) Mercury Drug dominates the **retail sector**, with a 40% share of the national market, and an even higher proportion of the market in Metro Manila. Its competitors are very much smaller, and include both Metro and Rose Pharmacy.

Distribution margins are fairly standard throughout the industry, with distributors earning between 15% and 18%, and retailers earning about 10% to 15%. This is further discussed in Appendix 3-20, but it should be emphasised that these margins are only applicable to pharmaceuticals in their final dosage forms. Bulk chemicals are industrial as opposed to consumer products and, as such, are marketed differently. They do not use intermediaries to distribute as there is no need. They only have a limited number of customers with whom they negotiate directly for supply contracts

3.5.1.7 Sales and Distribution Costs

As noted above, there is already a trend away from in-house distribution to use of the established network of supply channels in the Philippines. Although this inevitably reduces the margin to the manufacturer, it also simplifies the sales structure and limits the costs of distribution to that of delivery to the wholesale outlet (probably within Metro Manila).

Other costs related to marketing include that of sales administration, advertising and product promotion, direct sales representation to doctors and pharmacists throughout the country, product seminars and technical literature, entertainment, etc. All these costs would have to be absorbed by the manufacturer.

However, the costs of selling bulk chemicals are much lower than those associated with the marketing of final dosage forms, given that the former are industrial as opposed to consumer products. In particular, the number of potential customers is limited, to probably no more than 30 in the case of bulk semi-synthetics, and as few as 3 in that of 6-APA. Sales administration would therefore be much simplified, advertising would be largely unnecessary and day-to-day marketing could be handled by a relatively small sales force.

This point is further discussed in each of the sections relating to the sales and marketing of the individual product lines proposed (namely : section 3.6.4 through to section 3.6.7 inclusive).

3.5.2 **A' ternative Marketing Strategies**

3.5.2.1 Appendix 3-21 reviews the alternative marketing options considered for the industrial chemicals and final dosage pharmaceuticals to be produced, and identifies the strategy selected for each. These may be briefly summarised as follows for ease of reference.

3.5.2.2 **Industrial Chemicals**

As the production of animal feeds is a different field of industrial activity to that of chemicals, **Pen-G feedgrade** should be sold in bulk to existing animal feed producers, as opposed to being further processed on-site.

The market for **Pen-G** can be served either directly by packaging unit doses or indirectly by selling in bulk to other companies. The latter course is more cost efficient and would yield a higher net revenue to the production facility.

6-APA would be treated as a buffer stock : some would be used as the basic raw material for the next stage in the manufacturing process, and the remainder would be sold to the three producers of semi-synthetic penicillins. The anticipated shortfall in supply to the latter would be made up by direct imports.

The market for **bulk semi-synthetics** would be highly competitive, and sales could be inhibited if the company also competed with its own customers in the market for final dosage forms. These chemicals would therefore have to be sold on the basis of quality and service.

3.5.2.3 **Final Dosage Pharmaceuticals**

The market for final dosage semi-synthetic penicillins is effectively saturated, with over 50 brands of both amoxycillin and ampicillin currently being available. In each case, three or four brand names dominate the market.

The company could seek to establish a significant market share, but this would take many years to achieve and could prove to be prohibitively expensive. The most profitable strategy would be to contain marketing costs by concentrating on the supply of generic drugs to the private sector, notwithstanding the fact that this places heavy reliance on government policy with regard to educating doctors in the use of such drugs.

3.5.2.4 Further details in respect of each of the foregoing are set out in Appendices 3-22 to 3-25 inclusive.

3.6 SELECTED SALES PROGRAMMES AND MARKETING STRATEGIES

3.6.1 Strategy Presentation

3.6.1.1 The marketing strategies selected all assume that the government of the Philippines would provide a measure of support for the proposed new project through the introduction of higher tariff barriers to discourage imports.

3.6.1.2 However, further action could be taken to consolidate such support through a review of present government purchasing policies, whereby preference would be given to those suppliers which used domestically produced bulk pharmaceuticals.

3.6.1.3 In addition, the overall marketing strategy of the company should be linked as closely as possible to the efforts which are now being made by government to publicise the National Drugs Strategy. This would give it credence both within the pharmaceutical industry and amongst doctors and pharmacists.

3.6.2 Pre-Production Promotion

3.6.2.1 Product promotion during the project implementation phase is essential if future sales objectives are to be met. In particular, management would have to work closely with the authorities in order to ensure that the requisite USFDA approvals were forthcoming as soon as possible after the start-up of operations.

3.6.2.2 A carefully planned public relations programme would also have to be initiated to introduce the company and its objectives to the industrial and commercial sectors of the economy, as well as to the medical profession.

3.6.3 Selection of Sales Programme

3.6.3.1 It is throughout important to distinguish between bulk chemicals and final dosage pharmaceuticals :

a) Natural penicillin, 6-APA and bulk semi-synthetics would be sold in bulk form to other industrial companies for processing and packing. This type of business could be handled by a relatively simple marketing operation.

b) Final dosage pharmaceuticals would be sold to the public in small unit quantities, and therefore require specialised packaging, sophisticated distribution and the use of a large sales force to influence prescribers.

3.6.3.2 Although some economies of scale could be achieved by combining the marketing of the three industrial chemicals, final dosage sales would need to be handled completely separately.

3.6.3.3 The sales and marketing strategies for each of the products under review are fully detailed in Appendices 3-22 to 3-25 inclusive. However, the salient points are set out below for ease of reference.

3.6.4 Sales/Marketing Strategy for Natural Penicillins

3.6.4.1 **Strategy Selected**

The company should concentrate on selling in bulk to the major importers of feedgrade penicillin, and to the established manufacturers of pharmaceutical products.

3.6.4.2 **Product Pricing**

It has been assumed that feedgrade and pharmaceutical quality Pen-G would each be priced at a level which would give the domestic product a cost advantage of about 10% viz-a-viz imported material :

Feedgrade Pen-G	:	US$ 25 = P 650 per kg
Clinical Grade Pen-G	:	US$ 50 = P 1,300 per kg

3.6.4.3 **Product Promotion**

High quality technical literature would be distributed to support the sales effort, but the main thrust of the marketing campaign would be the organisation of factory visits and product seminars for doctors, pharmacists and other direct customers. Expenditure on these items has been estimated at a total of P 300,000 per annum.

3.6.4.4 **Organisation of Sales and Distribution**

The small customer base for natural penicillins could be handled by one top-grade salesman, supported by the sales director and specialist staff to give assistance as appropriate. The most difficult task would be to convince the customer of the quality and reliability of the product, and thereafter to ensure a continued high level of technical support. It is estimated that expenditure would total about P 880,000 per annum.

3.6.4.5 **Commissions/Discounts**

Prices have been quoted on an ex-factory basis, net to the customer, and with no provision for commissions or discounts. In reality, however, sales would be subject to negotiation by the parties concerned. Large buyers would probably be able to obtain a discount on the average prices we have used whereas small buyers would pay a premium.

3.6.5 **Sales/Marketing Strategy for 6-APA**

3.6.5.1 **Strategy Selected**

Part of the total output of 6-APA would be kept as the basic feedstock raw material for further processing in-house, and the balance would be sold to the three other domestic producers of semi-synthetic penicillins.

3.6.5.2 **Product Pricing**

It has been assumed that the locally produced 6-APA would be priced at a level which would give it a cost advantage of 10% - 12% viz-a-viz imports. Although the world market price of 6-APA fluctuates considerably, current levels would imply a domestic price of :

6-APA : US$ 69 = P 1,794 per kg

3.6.5.3 **Product Promotion**

It is estimated that total expenditure on technical literature, product promotion and entertainment would not exceed P 135,000 per annum.

3.6.5.4 **Organisation of Sales and Distribution**

Given the very small customer base for 6-APA, it should not be necessary to recruit additional specialist staff to cover this aspect of the company's operations. It has therefore been assumed that initial sales would be handled by the Sales Director, and that all further customer liaison would be handled on an on-going basis by the sales staff and back-up services working with the company's clients for natural penicillins.

3.6.5.5 **Commissions/Discounts**

The price of 6-APA has been quoted on an ex-factory basis, net to the customer. For the purpose of this study, it has been assumed that commissions/discounts would not be allowed, although these would be subject to negotiation.

3.6.6 **Sales/Marketing Strategy for Bulk Semi-Synthetics**

3.6.6.1 **Strategy Selected**

Given that the established competition in the market could make it very difficult for a new entrant, the company should aim to secure its place through close customer liaison and by offering superior technical advice and support as part of its sales service.

3.6.6.2 **Product Pricing**

Based on current world prices, and subject to a new tariff level of 30% for bulk semi-synthetics, the proposed project should be able to compete against imports and other domestic producers if it fixed its prices at the following levels :

Bulk Ampicillin	:	US$ 77 = P 2,002 per kg
Bulk Amoxycillin	:	US$ 90 = P 2,340 per kg
Bulk Cloxacillin	:	US$ 110 = P 2,860 per kg

These prices would represent cost savings to the client of about 8% to 12.5% relative to imported products.

3.6.6.3 **Product Promotion**

It is anticipated that, in addition to distributing high quality technical literature, the proposed new venture would have to take steps to raise its profile by designing a corporate brochure. This would be used to supplement a programme of regular factory visits and product seminars for doctors and pharmacists. It is estimated that expenditure on these items, plus direct product promotion and entertainment, would total about P 520,000 per annum.

3.6.6.4 **Organisation of Sales and Distribution**

The marketing strategy selected assumes that the company would establish a separate sales office to operate in the commercial capital, and that a highly qualified technical sales manager would be employed to guarantee the availability of specialist advice and support to customers. On this basis, it is estimated that expenditure on sales/distribution would total about P 780,000 per annum.

3.6.6.5 **Commissions/Discounts**

As with the natural penicillins and 6-APA, all prices have been quoted on an ex-factory basis, net to the customer, and no provision has been made for discounts or commissions. In reality, however, every sale would be subject to negotiation.

3.6.7 Sales/Marketing Strategy for Final Dosage Forms

3.6.7.1 **Strategy Selected**

The company should concentrate on supplying generic products to the private sector in order to secure a 2% share of the overall market for final dosage forms. The distribution function would be delegated to one or more of the specialist wholesalers, but it would still be necessary to operate a national sales force in order to establish direct contact with the end-user.

3.6.7.2 **Product Pricing**

It has been assumed that, in order to demonstrate the cost advantages of the generic product, prices would be set at discount of approximately 40% relative to those of the market leader in each instance :

Ampicillin	Capsules	:	US$ 248 = P 6,443 per kg
	Syrups	:	US$ 566 = P 14,726 per kg
Amoxycillin	Capsules	:	US$ 441 = P 11,466 per kg
	Syrups	:	US$ 720 = P 18,720 per kg
Cloxacillin	Capsules	:	US$ 404 = P 10,500 per kg
	Syrups	:	US$ 944 = P 24,554 per kg

3.6.7.3 **Product Promotion**

In view of the extent of established competition in the market for final dosage forms, it is anticipated that considerable sums would have to be spent on promoting the company's products. This would be over and above expenditure on technical literature, factory visits, etc, and provision has accordingly been made for 5% of the sales revenues in each year to be allocated to medical advertising, product promotion and customer relations.

3.6.7.4 **Organisation of Sales and Distribution**

The proposed sales force would comprise a team of 25 sales representatives, operating out of one national and two regional sales offices, who would market the product direct to doctors and pharmacies on an on-going basis. The total cost of this, inclusive of the salary cost of a second Sales Director and support staff, has been estimated at just over P 6.1 million per annum.

3.6.6.5 **Commissions/Discounts**

It has been assumed that, in order to guarantee maximum promotion of the company's products, it would also be necessary to offer preferential trade discounts and/or sales commissions to the wholesalers appointed. These are likely to average at least 2.5%, calculated by reference to gross sales revenues.

3.7 ESTIMATE OF SALES REVENUES AND COSTS

3.7.1 Sales Revenues by Manufacturing Option

3.7.1.1 Full details of the build-up in sales revenues by individual product, calculated by reference to forecast sales and the prices which have been assumed for these product, are presented in Appendix 3-26.

3.7.1.2 These figures form the basis for Appendix 3-27, which sets out the sales revenues derived in terms of each of the manufacturing options under review. However, these revenues may also be summarised as follows for ease of reference and comparison :

Projected Sales Revenues : Option A in P '000

	1995	2000	2005	2010
Pen-G	10,400	57,200	57,850	60,450
6-APA	96,876	175,094	203,619	192,317
Bulk Product	38,610	123,240	148,356	185,354
Dosage Forms	10,079	53,955	66,920	82,613
	155,965	409,489	476,745	520,734

Projected Sales Revenues : Option B in P '000

	1995	2000	2005	2010
Pen-G	-	-	-	-
6-APA	105,667	222,635	252,057	242,728
Bulk Product	38,610	123,240	148,356	185,354
Dosage Forms	10,079	53,955	66,920	82,613
	154,356	399,830	467,333	510,695

Projected Sales Revenues : Option C in P '000

	1995	2000	2005	2010
Pen-G	10,400	57,200	57,850	60,450
6-APA	117,328	240,575	281,299	287,937
Bulk Product	-	-	-	-
Dosage Forms	-	-	-	-
	127,728	297,775	339,149	348,347

3.7.2 Sales and Distribution Costs by Manufacturing Option

3.7.2.1 Appendix 3-28 details the expenditure which would be directly related to the sales and marketing of the output of each of the three manufacturing options. It also provides a breakdown of total costs by individual product and cost heading : manpower, product promotion, travel/transport, office rental and sales commissions.

3.7.2.2 Once again, these may be summarised as follows :

Projected Sales Costs : Option A in P '000

	1995	2000	2005	2010
Manpower	6,285	6,285	6,285	6,285
Product Promotion	1,889	4,083	4,731	5,516
Travel	620	620	620	620
Office Rental	750	750	750	750
Commissions	252	1,349	1,673	2,065
	9,796	13,087	14,059	15,236

Projected Sales Costs : Option B in P '000

	1995	2000	2005	2010
Manpower	6,285	6,285	6,285	6,285
Product Promotion	1,469	3,663	4,311	5,096
Travel	620	620	620	620
Office Rental	750	750	750	750
Commissions	252	1,349	1,673	2,065
	9,376	12,667	13,639	14,816

Projected Sales Costs : Option C in P '000

	1995	2000	2005	2010
Manpower	680	680	680	680
Product Promotion	555	555	555	555
Travel	80	80	80	80
Office Rental	-	-	-	-
Commissions	-	-	-	-
	1,315	1,315	1,315	1,315

****

3.8 PRODUCTION PROGRAMME

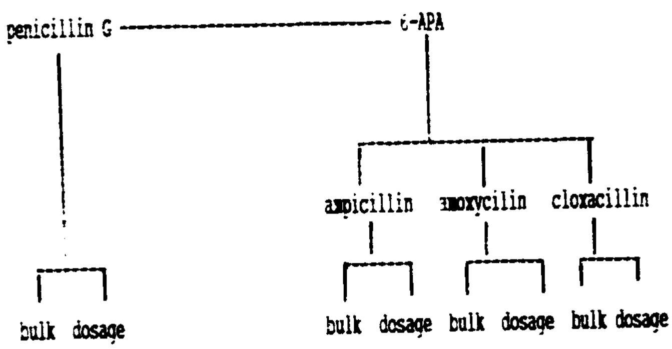
3.8.1 Data and Alternatives

The starting point for compiling the production programme follows the work done in the marketing section to forecast the following products in bulk and final dosage form:-

- Penicillin G
- 6-amino penicillinanic acid (6-APA)
- ampicillin
- amoxycillin
- cloxacillin

As shown in Figure 3.8.1, the key product is penicillin which can be used in its own right as an antobiotic or alternatively used to prepare bulk 6-APA which is the intermediate required to manufacture ampicillin, amoxycillin and cloxacillin.

Figure 3.8.1 Routes to final product



3.8.2. Manufacturing Options

The terms of reference for this study, see Appendix 1.1, required the following options to be taken into account as requested by UNIDO and the Philippine Government. These options are summarised in Table 3.8.2:-

Table 3.8.2 Manufacturing Options

Option	manufacture in bulk	manufacture in dose form
A	penicillin G, 6-APA, semi-synthetic penicillins,	penicillin G, semi-synthetic penicillins,
B	6-APA, semi-synthetic penicillins,	penicillin G, semi-synthetic penicillins,
C	penicillin G, 6-APA,	-

The above options will usefully demonstrate:-

- the high level of resources required for bulk penicillin production relative to the other products which is seen by comparing Options A and C to option B. The reason for this difference in resources is the massive and expensive support structure required for penicillin which is not required for any of the other products themselves if they were manufactured from imported bulk penicillin G,
- the relative benefits or otherwise of combining bulk chemical manufacture with pharmaceutical manufacture by comparing Option C with Options A and B.

3.8.3. Demand Projections

Table 3.8.3A shows the demand for each end product in 1990 and is the starting point in determining the production schedule.

Table 3.8.3A Actual Demand - products derived from bulk penicillin 1990

(units: tonnes per year expressed as Penicillin G)

penicillin	ampicillin	amoxycillin	cloxacillin	Total
44	61	71	8	184

The marketing sections of this Report have established (Appendix 3-10, Table 3.1) forecasted demand and forecasted sales for Penicillins to 2010 and these are summarised in Tables 3.8.3B and fully detailed in Appendix 3-30.

Table 3.8.3B Forecasted Demand Summary - penicillin and derivatives 1990-2010 - All options

(Units: tonnes/year expressed as Penicillin G)

Year	1990	1995	2000	2005	2010
Tonnes	184	335	428	514	630

Based upon the forecasted demand, the sales forecast in Appendix 3-30 has been established for all options after taking into account the effects of the anticipated market penetration and build-up of sales from the new facility. Also taken into account is the practicalities and the ability of the manufacturing plant to provide the products for sale in sufficient quantity.

3.8.4 Selection of Production Schedule

The production schedule is designed to satisfy the needs for the products summarised in table 3.8.4.

Table 3.8.4 Production Schedule - Possible Products

product	option	form	grade	sold/ consumed	use
pen G	A,C	bulk	pharmaceutical	sold	dosage
pen G	A,C	bulk	technical	sold	animal feed
pen G	A,C	bulk	technical	both	6-APA
pen G	A,B	dose	pharmaceutical	sold	dosage
6-APA	all	bulk	technical	both	semi-synthetic
semi-syn	A,B	bulk	pharmaceutical	both	dosage
semi-syn	A,B	dose	pharmaceutical	sold	dosage

(semi-syn. or semi-synthetic penicillins, include amoxycillin, cloxacillin and ampicillin)

Based upon the forecasted sales to 2010, the following assumptions have been made to determine a production schedule for the plant starting from the known demand of 184 tonnes in 1990:-

- the plant will start up in 1995.
- the future plant will handle the total actual demand in 1990 and all subsequent increases in forecasted sales.

- the actual output from the plant will be subjected to reductions caused during start-up and initial commissioning. In the first year, 1995, only 50% of output will be realised, then 80% in 1996, and 100% in subsequent years.

- an allowance of three years, from 1992 until 1994 is made to complete the design and installation of the plant.

- the sales plan discussed in the marketing section reference Appendix 3-11 is adopted.

- three fermenters will be required until 2000 after which an additional unit will be required.

After taking the above assumptions into account, Appendix 3-30 summarises the production schedule for the period 1995-2010.

This production schedule is the basis for all estimating of the plant operating and capital costs.

The production schedule shows that most of the penicillin is used by the plant for manufacture of downstream products and only a small proportion of the output from the production programme will be consumed as penicillin G - for low grade animal feed additive and a more significant amount which is designated for human dosage.

3.8.5 Calculation of Production Schedule

The production schedule for penicillin shows the required output for each of the products listed, converted into tonnes per year of the starting material penicillin G. Figure 3.8.1 shows how all these products are related to penicillin G and hence once the quantity of each end product is known, the required amount of penicillin is evaluated.

The required quantities of the intermediate 6-APA are also determined from the scheme illustrated in Figure 3.8.1, as the amount of each semi-synthetic relates simply and arithmetically to the required amount of 6-APA. The semi-synthetic penicillins in bulk and final dosage form, therefore determine the production programme for 6-APA, although any discrepancy, surplus or shortfall in 6-APA can in practice, be balanced by trading on the existing international market for this product. The production programme makes use of this facility to improve the use of resources and to reduce financial risk.

Concerning the products in their final dosage form, the production schedule is simplified, firstly because the machinery required to manufacture the tablets or capsules does not have to be dedicated to one product only, and secondly, the total output of final dosage products is small and considerably less than the output from the smallest automatic machinery running on a single shift basis. Given these circumstances, there is no need to build in any form of extra capacity or elasticity into the production programme.

3.8.6 Quality standards

The plant design is intended to meet internationally acceptable quality levels with the United States (USP) or British Pharmacopoeia (BP) standards.

This is particularly important in the event that the plant will want to export its pharmaceutical products in the future, the product quality has to be designed to a standard which will be acceptable to the Regulatory Authority of any importing country. In the USA for example, imports must comply with the standards set down and checked by the Food and Drug Authority (FDA).

The requirement for the high quality standards particularly affects the design of the plant for the final dosage products which must be produced under strict rules known internationally as Good Manufacturing Practice (GMP).

A small quantity of Penicillin is sold to a lower specification for use as an animal feed additive.

The 6-APA produced is in reality an intermediate chemical produced and sold in bulk and which does not require to be manfactured to Good Manufacturing Practice (GMP) standards.

3.8.7 Waste Treatment

In common with other biotechnology plants, the present proposal mostly operates at or near ambient temperature and pressure and does not issue waste products which are generally regarded as harmful. The highest volume of waste formed from the manufacturing process is spent broth and water washings which consists mainly of water and non toxic protein and inorganic chemicals in a dilute form. This type of waste can easily be treated in city waste treatment plants or can be dealt with in a separate plant working on the activated sludge principle.

There are some organic materials, mainly solvents such as acetone which are normally re-cycled in the production process, and although inevitably there are some losses which escape in the water or as airborne pollution, these are normally capable of being controlled. The spent mycelium can easily be recovered by filtration from the broth and can be sold to animal feed manufacturers.

Although the plant should be considered as a medium sized chemical works and should not, for example, be sited close to a residential area, serious problems from other forms of pollution such as noise, toxic wastes or dusts are not expected.

3.9 PLANT CAPACITY

3.9.1 Definition of Terms

For all the products under consideration, the production schedules in Appendix 3-30 have been used to calculate the operating expenses - raw material consumption and labour costs.

However, as paragraph 3.9.2 shows, the plant design and space requirements for the plant have been estimated on the basis of the plant design capacity, which has been computed from the production schedule after the addition of engineering contingencies and production losses for each of the principal production units - penicillin plant, 6-APA plant, semi-synthesis plant and dosage forms plant.

3.9.2 Penicillin Plant - Design Capacity

3.9.2.1 Determination of Design Capacity

Table 3.9.2.1 summarises the design capacity for the bulk penicillin plant. This is determined directly from the production schedules summarised in Appendix 3-30 after making appropriate allowances for plant losses and potential engineering uncertainties such as difficulties in scale-up.

Table 3.9.2.1 Design capacity of Penicillin Plant.

(Units: tonnes/year Penicillin G)

	Production Schedule	Design Capacity	Utilisation %
1995	130	286	45
2000	297	582	75
2005	340	382	89
2010	349	382	91

The contingencies are intended to cover:-

- insurance against under performance of machinery,
- engineering error and unknown factors such as scale-up and other uncertainties,
- a means to benefit from expected future improvements in productivity obtained through strain development.
- losses in output in the penicillin extraction and purification stages.

3.9.2.2 **Allowance for increasing Production 1995-2010**

Although the plant operates continuously throughout the year, it nevertheless functions in a batch mode and the output varied by adjusting the number of batches made.

Since it is unnecessary and impractical to re-design the plant on a year by year basis to cater for each small annual increment in throughput forecast in the production schedule in Appendix 3-30, the plant will have excess capacity until 2000 when it will be in balance. After this date it is foreseen that extra fermentation capacity will be installed sufficient to cater for the anticipated sales until 2010.

3.9.3 <u>6-APA DESIGN CAPACITY</u>

The production schedule for 6-APA production as shown in Appendix 3-30 comprises sufficient 6-APA to manufacture the required semi-synthetic penicillins in bulk and final dosage forms, plus the quantity of 6-APA to be sold in bulk to the the home and export markets.

This table shows the forecast output from the plant over the period to 2010 varies from a minimum of 189 tonnes of Penicillin G equivalent in 1996 to a maximum of 296 tonnes in 2009.

Since there are no practical savings in resources or technical benefits to be gained in starting the project with a smaller unit of plant, the 2009 figure has been used as the starting point for the plant design capacity.

As the figures in Appendix 3-30 are in terms of penicillin, they are first re-calculated to give the equivalent weights in 6-APA and then a 20% engineering margin is added to cater for the engineering contingencies. This calculation is summarised below in Table 3.9.3.

Table 3.9.3 Production Schedule 6-APA 1995-2010 All options

(Units tonnes per year)

Option	Output from Appendix 3-30 - as Pen G			as 6-APA
	6-APA	semi-synthetics	total	total
A	197.3	99.6	297	160.4
B	249.8	69.2	319	172
C	297	-	297	160

Again the plant is operated batchwise and as shown in the table there is a requirement for a maximum of 160-170 tonnes of 6-APA for any of the three options. After the application of the engineering allowance of 20%, the plant has been designed for a 200 tonne per year output or 330 batches of 600kg per year.

From a commercial point of view, 6-APA is traded as a commodity in the international market and any surplus material produced in the proposed plant can easily be sold or shortfalls made up by making use of this facility. Whilst it is intended that most of the output from the new facility will be sold locally to Chemfields and any future competitors who will consume the bulk product in their existing programmes to manufacture semi-synthetic penicillins in bulk and final dosage form, there are reasonable possibilities to export the bulk material.

3.9.4 Semi-Synthetics Design Capacity

For options A and B, inspection of the production schedule in Appendix 3-30 for the three selected semi-synthetic antibiotics, ampicillin, amoxcillin and cloxacillin, shows the output requirements are too small to justify an incremental build-up in the plant design capacity. Hence, the design capacity shown in Table 3.9.4A has been based upon the the maximum requirement for the period 1995-2010 converted from tonnes of penicillin in table 3.9.4B to actual tonnes of each semi-synthetic.

There is no call for the semi-synthetics in Option C.

Table 3.9.4A Maximum Production Schedule 1995-2010 Semi- Synthetics - Options A and B only

(units: tonnes per year)

ampicillin	10
amoxycillin	62
cloxacillin	11

The production schedules for the plants are then increased by the 20% engineering allowance and the design capacities are as shown in Table 3.9.4B.

Table 3.9.4B Design Capacity; Semi-Synthetic Plants Options A and B only

	tonnes per year	batches per year
ampicillin	12	48x250kg
amoxycillin	75	300x250kg
cloxacillin	13.5	70x200kg

A separate plant is required for cloxacillin production but the process for the manufacture of ampicillin and amoxycillin is by an almost identical process which uses the same process plant and similar raw materials.

3.9.5 Dosage Forms for Options A and B Design Capacity

The design capacity for the products to be manufactured in Options A and B in final dosage form is summarised in Table 3.9.5. There are no dosage forms required in Option C.

Table 3.9.5 Design Capacity: Final Dosage Forms

product	tonnes per year
capsule	7
syrups	3

As the required output for dosage products is so small, the design capacity of the proposed facility is controlled by the smallest available sizes of mixing, filling and packing machinery working on a single shift basis. Clearly, the output from the same equipment could be increased threefold by altering working schedules to operate on a shift basis.

The production of dosage forms of pharmaceuticals requires the use of mixing, powder handling, filling, weighing and packaging equipment only.

3.9.5.1 Relationship of Manufacturing to the Market Conditions Found

Although the machinery selected will be capable of being used for ampicillin, cloxacillin, amoxycillin and penicillin, following the market information received, (see Appendix 3-25), no provision has been made to produce tablets, creams or ointments on this plant.

In manufacturing and marketing terms, the addition to the production programme of fairly small quantities of penicillin G, amoxycillin, ampicillin and cloxacillin in dosage form to the output from what is otherwise a medium sized bulk chemical plant is a radical one. It departs from the main provisions for the manufacture of bulk chemicals and special provisions for pharmaceutial manufacture are required. It also requires high quality buildings and machinery designed to GMP standards and a strict Quality Control programme.

Although there is an existing market for penicillin in dosage form, the prospects of selling a well developed product to wholesalers, hospital pharmacies and others, in competition with international companies, are likely to be uncertain. The competition has the benefit of access to low cost large-scale production facilities outside the Philippines and a long history of selling their products locally - in what is really a akin to a "retail" type of operation.

Hence it has been considered unrealistic to assume the proposed plant could exploit this market and instead should concentrate its efforts in producing penicillin for human use in bulk form for sale to existing pharmaceutical manufacturers as well as for animal feed. In the event that the manufacturer of dosage forms of amoxycillin, ampicillin and cloxacilin is undertaken, there is scope to include penicillin in capsule or syrup form using the same equipment since this is likely to be under-utilised.

SECTION 4.

MATERIALS AND INPUTS

4.1 CHARACTERISITICS OF MATERIALS AND INPUTS

4.1.1 Classification of Requirements

For the fermentation process the cost of raw materials are most important and constitute a major proportion of the plant operating costs.

The types of raw material required for the products specified in this study consist essentially of local supplies of feedstock such as sugar and corn steep liquor for the fermentation process and fuel for steam raising, plus a range of about 30 different specialist inorganic and organic chemicals and solvents, all of which must be imported.

4.1.2 Material and Input Selection

Once the process design has been fixed, the raw materials in use are almost entirely governed by the requirements of the process and opportunities for choice are limited to:-

- the use of alternative local supplies of carbon source for the fermentation process, for example sucrose has been selected for this study because it is the cheapest suitable local product but other sources such as glucose could be substituted.

- alternatives in imported chemicals, particularly solvents, mineral acids and alkalis.

4.1.3 Raw Material Costs of Penicillin Manufacture

In Europe it is claimed that raw material costs amount to approximately 50% of the manufacturing costs of penicillin G manufacture; (reference; "Fundamentals of Biotechnology", Prave, VCH, Germany, 1987). Clearly this is already a high proportion and since Philippine raw materials and utilities - with the exception of sugar - usually cost <u>more</u> than in Europe, material costs are likely to be an even larger percentage in the Philippines.

By way of illustration, Table 4.1.3 shows the cost of the main raw materials used in the manufacture of Penicillin G - for Options A and C in this study. The column headed in dollar cost per kg of Penicillin produced illustrates the problems since the selling price of bulk Penicillin has for some considerable period been only $25 per kg.

Table 4.1.3 **Breakdown of Raw Materials Costs needed for Options A and C* - Penicillin G Manufacture**

	cost per tonne pesos	cost per tonne $	$ per kg of penicillin
Corn steep liquor	8 900	-	8.0
calcium carbonate		270	1.6
pot hyd phosphate		1 992	0.7
soy bean oil	21 000		1.9
ammonium sulphate		154	<0.1
ammonia		184	<0.1
sulphuric acid		100	<0.1
sucrose solution	7 350		2.7
phenyl acetic acid		1 086	4.1
butyl acetate		1 500	3.2
carbon		996	<0.1
sodium bicarbonate		881	0.3
butanol		1 166	1.1
total			24.3

* option B does not manufactiure penicillin.

4.1.4 The Effect of Choice in Process Route on Raw Material Selection

Whilst there are few options available to process engineers to modify the fermentation process for penicillin, there are some choices available in raw material selection for use in penicillin purification and in the production of the range of the semi-synthetic penicillins.

The preparation of complex organic chemicals to produce the semi-synthetic penicillins requires more than one sequential step involoving the production of several intermediate compounds. In such circumstances, the plant design is always finalised after consideration of the availability of alternative starting materials and intermediates on the local and world markets and on the technical complexity of the process.

Normally operating cost is the most important criterion to be taken into account by the chemists and process engineers before deciding which process route to adopt, but other considerations may sometimes override an economic decision, such as availability of supply, difficulty in selecting materials of construction for a particular step within a synthesis or an improvment to plant safety.

In this feasibility study Table 4.1.4 outlines important selections which have been made where alternatives were available. Where there was a choice between purchasing or making an expensive or unusual intermediate, manufacture was selected because this gives a greater security against interruption in supply.

Table 4.1.4 Choice affecting Selection of Process Route

* Options	process	selected	rejected
A,C	6-APA	enzyme process	chemical process
B	6-APA	imported penicillin	manufactured
A,C	semi-synthetics	manufactured intermediates	imported intermediates

The rule applied to this feasibility study has been to select Philippine raw materials where these are available and importing the remainder.

4.1.5 Local Supply of Materials

There are possibilities of local supply of corn steep liquor (CSL) used as a fermentation medium; sucrose solution which is needed as a carbon source and soya bean oil for the biological (fermentation) process.

Materials available locally are summarised in Tables 4.1.5A and B:-

Table 4.1.5A Consumption of Philippine Raw Materials

Options A and C only*
(units: tonnes per year)

	1995	2000	2005	2010
Soy Bean Oil	747	1,685	1,933	1,977
Sucrose solution 50%	1,459	3,289	3,775	3,861
Corn steep liquor 6%	25,766	58,108	66,691	68,208

* option B requires none of the above materials since all products are made from imported penicillin).

Table 4.1.5B Local Raw materials and Fuel- Delivered Prices

(units Pesos per tonne delivered)

CSL 50%	8,900
Sucrose	3,635
Soy Bean Oil	21,000

4.1.5.1 Corn Steep Liquor

CSL is a by-product from the manufacture of glucose from starch and is available in the Philippines from one or two specialist manufacturers of corn based derivatives. It is sold in the Philippines for animal feed additive as a suspension containing 6-7% solids. Each fermentation batch in this study consumes 85 cubic metres of a 50% solution of CSL, and in the year 2000, at the forecasted production schedule, this equates to a requirement for 7,000 tonnes per year of 50% strength CSL.

The cost of the CSL is of crucial importance to the economics of the penicillin fermentation process. Only 6% CSL is available at the present time in the Philippines and the suppliers have not been able to quote for 50% concentration. Accordingly, for the purposes of this study it has been necessary to calculate the cost of the 50% strength broth by adding the estimated cost of evaporation to the quoted price of 1-2 pesos per kg for the 6% supply.

After evaporation, the price of 50% CSL has been estimated at 9 pesos per kg, eqivalent to US $8 per kg or 33% of the raw materials cost of producing 1 kg of penicillin. Such a price is high when viewed against the international price for penicillin of $25 per kg.

4.1.5.2 **Sucrose**

Food grade sugar is widely available in the Philippines at a cost of 7,000 pesos per tonne and has been selected as the carbon nutrient for the fermentation process. The cost of the sugar is equivalent to $2.7 per kg of penicillin produced.

4.1.5.3 **Soya Bean Oil**

Soya bean oil is the other Philippine product which can be used in options A and C, for the fermentation process but the price of the local material is 25% more expensive than that bought in the USA for example.

4.1.6 Imported Raw Materials

Significant quantities of raw materials, the most important of which are summarised in Table 4.1.6.1, are used for all options A, B and C. The bulk materials consist of a wide variety of mainly specialist chemicals and solvents, none of which are made in the Philippines and which must be purchased on the international market.

Whilst supplies can be obtained direct from manufacturers, or through international commodity traders located in Europe, Japan or the USA, the probable best method would be to appoint a buying/shipping agent specialising in this type of commodity who would then group the supplies together for regular shipment to the Philippines by container.

Prices in the Philippines are subjected to increases in costs through application of tariff, freight and insurance charges.

4.1.6.1 Details of Imported Raw Materials

The principal raw materials required are normally technical grade chemical products and solvents, all of which are traded internationally as speciality chemicals and available in 25 or 50 kg sacks or 200 litre drums. None are normally considered dangerous and have shelf lives measured in years.
The amounts required for each option for the life of the project are shown in Appendix 4.1 to 4.3 Supply Schedules and summarised in Table 4.1.6.1.

Table 4.1.6.1 Consumption and Prices of Imported Raw Materials

(Costs based on delivered prices, duty paid. All costs and consumptions approximate)

		Price $/tonne	Requirements tonnes/year		
	option	1991	2000	2005	2010
Calcium carbonate	A,C	270	1778	2035	2206
Ammonium sulphate	A,C	30	1666	1965	1809
Butyl acetate	A,C	1500	1111	1571	1655
Sodium sulphate	A,C	145	1111	1309	1379
Phenyl acetic acid	A,C	1100	1000	1179	1242
Ammonia anhydous	all	135	1000	1179	1242
Methylisobutylketone	A,B	925	922	1087	1145
Acetone	all	1170	422	498	524
Hydrochloric acid 30%	all	90	278	327	344
Butanol	A,C	1166	278	441	465
Potassium hydrogen phosphate	A,C	1990	111	130	137
Sodium bicarbonate	A,C		100	118	124
Dichloromethane	all	900	50	58	68
Phenyl glycine	A,B	25600	28	32	37
Ethylacetoacetate	A,B	3250	22	26	30
P-hydroxyphenylglycine	A,B	25000	22	26	30
Ethyl chloro carbonate	A,B	17400	22	26	30
Tri ethylamine	A,B	3900	17	17	20
Ethanol anhydrous	A,B	1200	5	7	7
Active charcoal	all	nk	4	5.1	6
Sodium hydroxide	A,B	9660	nk		
Ethyl hexanoate	A,B	3250	2	3	4
Chlorophenylmethyl-isoxazolycarboxilic acid	A,B	tba	2	2	2

4.1.7 **Major Utilities**

The following major utilities are required.

Table 4.1.7 Utilities - Summary

Utility	Options	Use	Source
low pressure steam	all	sterilisation of vessels and raw materials	In plant
compressed air	A,C	sterile air to fermenters,	In plant
recirculated water	A,C	fermenter cooling	In plant
refrigeration	all	refrigeration	In plant
city water	all	washing down, cooling tower tower make-up, process water	Public
power	all	machinery drives	Public

4.1.7.1 **Public Utilities**

All the three Options A, B and C require use of the public utilities as summarised in Table 4.1.7.1, options A and C having substantial requirements:-

Table 4.1.7.1 Public Utilities

Option	Power MW public	Power MW standby	Public Water cu m per hour
A	8.2	8	180
B	0.5	0.5	10
C	8	8	180

4.1.7.2 **Stand-by Utilities Supply**

Although the demand for power is relatively high - at 8 MW for Options A and C, the average usage of steam at 1-2 tonnes per hour is too low to justify a co-generation scheme from being considered for any of the Options.

Options A and C will require the use of a public medium voltage power supply with stand-by diesel generators, together with a reliable supply of cooling and washing water.

The Penicillin fermentation process takes 9 days and once started, it cannot be stopped or otherwise interrupted for more than a few seconds at a time. The consequences of failure of the electrical supply to the fermentation process for more than two or three minutes will lead to the loss of up to three complete batches - and since each batch takes nine days to complete and contains almost 3000 kg of penicillin, the value of such a loss at the current international bulk price of penicillin G of $25 per kg would be approximately $200 000. This makes the installation of stand-by power generation desirable.

Other utilities such as steam, instrument air, water and refrigeration already have sufficient elasticity built into their systems and there is no extra need for stand-by capacity to be included for these items.

4.1.7.3 Fuel

Locally refined heavy oil is used as fuel for steam raising. In 1991 heavy fuel cost 5.3182 pesos per litre delivered to the industrial area south of Metro Manila.

Table 4.1.7.3 summarises the approximate consumption of fuel oil required for steam raising.

Table 4.1.7.3 Approximate Boiler Fuel Consumption

(Units: tonnes per year)

Option A	Option B	Option C
2050	890	1450

During the survey period in 1991, bagasse was available as an alternative fuel on a seasonal basis in sugar growing regions in the Philippines, for example in Cebu. However it was no longer possible to purchase reliable local supplies of bagasse or other waste fuel in the Metro Manila region. The considerations necessary to select a suitable site for the process plant are discussed in more detail in Section 5.1 of this report. Even if bagasse were available in the Metro Manila region, it is a seasonal crop which does not store well and is therefore not suitable as a fuel for consideration in this study.

4.2 SUPPLY PROGRAMME

4.2.1 Supply Programme Schedules

Appendices 4-1 to 4-3 inclusive set out the fully detailed annual raw material and utility requirement to support the production schedules for each of the respective options A, B and C. All inputs are identified by both quantity per batch for years 1995 to 2010.

4.2.2 Supply Programme Determination

Appendices 4-1 to 4-3 were generated directly from the production schedules (Appendix 3-30) after determination of:-

a) component material requirements drawn from the material balances calculated in the working papers set out in Volume III of this study.

b) component procurement and storage requirements.

4.2.3 Component Procurement and Storage Requirements

4.2.3.1 Local Raw materials

The important local raw materials CSL, sugar, fuel oil and soya bean oil, would be delivered by road tankers of nominal capacity 30 tonnes into bulk storage tanks. Table 4 2.3.1 summarises the storage requirements:-

Table 4.2.3.1 Local raw materials Stock (Options A and C)

(units: tonnes based on 2000)

	average usage/day	days storage
CSL	20	10
Sucrose	10	10
Soya Bean Oil	5	10
Fuel Oil	4-6	6

It should be noted that none of the above local raw materials are required for Option B.

4.2.3.2 Imported Raw Materials

Stocks of imported materials need to be anticipated and Table 4.2.3.2 shows that about 4-5 months stock is necessary.

Table 4.2.3.2 Imported Ingredients: Basis for stock Policy

weeks	action
2	shortage of stock to be reported
1	order placement
4	delivery to port
4	shipping
2	clear customs and local delivery.

The imported raw materials are normally handled with a fork lift and stored in standard racking. Most products are supplied in metal drums of 200 litre capacity, 25 or 50 kg plastic sacks, or in cartons, drums and packs of various sizes.

SECTION 5

LOCATION AND SITE

5.1 LOCATION

5.1.1 Criteria and Selection

A good location for the site is important to the future success of the manufacturing plant and Table 5.1.1 summarises the key considerations which have been taken into account.

Table 5.1.1 Criteria for Location Selection

personnel	availability of pharmacists*, bio-technologists*, engineers, laboratory, instrument, plant maintenance technicians, access to University*.
site	industrial site* with adequate infra structure; power, transport, roads, water, waste treatment.
location	good access* to and from ports, air ports, roads, work force*, University*, sales distribution networks, customers, national policy.
area	one hectare for Options A and C, 0.5 ha for Option B.

(* highly important)

The location should provide a level site, away from residential areas but close enough to be accessible for personnel and deliveries. There are no special needs for the process plant envisaged with the exception that Options A and C, require at least an 8MW power supply together with a plentiful supply of water - mainly for washdown and cooling tower make-up.

5.1.2 Possible Locations

The selection of a suitable site began with discussions with the Philippine team members who recommended the following as possible locations:-

- South Metro Manila Region
- Batangas - south of Manila
- Cebu
- Mindanao - Cagyan de Oro City or Iligan

A location map is set out in Appendix 5-1.

Table 5.1.2 summarises the factors influencing the choice of location:-

Table 5.1.2 Factors affecting choice of Location

	Metro Manila	Batangas	Cebu	Mindanao
personnel availability	x	x		
close to Los Banos University	x	x		
infra structure	x	x		
ports, airports	x	x	x	x
close to customers	x	x		
close to sugar products			x	x

5.1.3 **Special Note**

It was not possible to take full account of certain areas in the country, particularly those away from the Metro Manila region, since at the time of the survey in 1991, Mount Pinatubo errupted and this not only devastated a large area to the North of Manila, but also stopped all air travel within the region.

5.2 SELECTION OF LOCATION

5.2.1 South Manila Region - Advantages

The optimum area for the location of the project is in the region south of Metro Manila. Whilst the disaster prevented all of the sites from being viewed, it is unlikely that this would have affected the recommendation to locate in this region. There were good reasons to select a site in this region, firstly because of the importance of finding an industrial site close to a large population centre, and close to the existing biotechnology facilities centred around the University of the Philippines at Los Banos. The proposed region is 20-70 km distance from Manila and is the only location which meets all the criteria set out in table 5.1.1 Road access to the Manila area is by a four lane highway. This location is an approved industrial area in accordance with the government's policies for industrial socio-economic and environmental development.

Other similar types of large process plants installed recently in the vicinity of this area include:-

- Coca Cola,
- Ciba-Geigy,
- Swiss Pharma,
- Chemfields.
- Wyerth Laboratories,
- Unilab,
- Bayer Philippines,
- Boehringer Ingelheim

5.2.2 **South of Metro Manila Area - Disadvantages**

Whilst the south Manila area allows close liason with the University of the Philippines at Los Banos, access to highly trained staff and to a good public power supply; as discussed in Section 4.1 of this report, there is no longer a reliable supply of waste fuel from bagasse or coconut shells in the surrounding area. This is a disadvantage which would lead to higher operating costs, but since the supply of low cost fuel can never be guaranteed in the long term, it was not allowed to influence the recommendation to locate in the south Manila area and not close to the sugar refineries elsewhere in the country.

5.3 SELECTION OF SITE

5.3.1 Alternatives Considered

The Calabarzon and adjoining Laguna area south of Manila (see Appendix 5-2) is one which has been designated by the Government for development and also accounts for 13.7% of the Philippine population.

Several sites are being developed as industrial estates in the Santa Rosa, Cabuyao, Carmelray Calarbazon and Canlubang districts. These sites are all located within 15 minutes by road from one another in various phases of what is in reality the same development.

Please see Appendix 5-3 for photographs showing typical factories in these areas.

5.3.2 The Light Industry Science Park - Canubang

A suitable site was found in the Light Industry & Science Park of the Philippines in Canubang in the Calabarzon region. Please see Appendix 5-4 for details of the site. It is being developed and managed by a consortium including the Philippine Government, Bechtel and various private Philippine companies. A brochure is shown at Appendix 5-5.

The site is managed by Science Park of the Philippines Inc. and consists of 142 hectares divided into approximately 100 industrial lots, each 1 hectare, only nine of which had been sold at the time of the survey in June 1991. The site condition is go[illegible] ground is levelled with internal roads and [illegible] provided to each factory by the developer.

The site is situated 35 km south of Makati which is the commercial centre of Metro Manila and has direct access via the South Expressway. Special bus transport for workers is also available.

It is thus outside Metro Manila suburban conabation and complies with the Government's Industry Dispersal Programme. Companies located within the Park can qualify for investment incentives no longer available to those in Metro Manila itself.

The Park is 38 km from Ninoy Aquino International Airport, 42 km from the South Harbour and 3 km from the nearest railway station. The Park is located in the Calabarzon area which accounts for 5.5% of the country's land mass and 14% of the population. During a 3 year period starting in 1989, the National Manpower and Youth Council has established provincial skills training centres within the region. Calabazaron has been designated by the Government as a priority area for development.

The major shareholder in the Science Park is the Investment and Capital Corporation of the Philippines. Other shareholders are the AIG/Philippine American Life Insurance Company, Bechtel Investments of the USA and the Government-owned National Development Company.

In the future, it is envisaged that there will be a close relationship between the Science Park and the University of the Philippines, who are expected to provide training and research/development facilities.

A variety of housing is available within the region.

5.3.3 Features of Light Industry Science Park

Particular features worthy of note are:-

- good quality water supply from deep wells,complete with a 3,200 cu m storage tank for a total supply of 500 cu m per hour.

- primary power supply rated at 34.5 KV, 3 phase, stepped down to 460/230 volts through 3x333 KVA transformers. Power service is provided by the Manila Electric Company.

  Approximately 80 MW capacity is available for the site and in Summer 1991 most of this had not yet been allocated, hence there was more than enough for the maximum power of 8MW foreseen for Options A and C on this project. A sub-station is required and this has been costed in our estimates.

- 500 telephone lines are provided by the Philippine Long Distance Telephone Company.

- There is an existing waste water treatment plant facility, the details of which were not available at the time of the survey. A additional allowance for waste water treatment has been made in the capital cost estimates to cover this point.

- There is a common site Customs bonded Zone.
- Public services include; security force, post office, and clinic, bank, restaurants, recreation park.

5.4 COST ESTIMATES

A one hectare site is required costing 12,000,000 pesos for options A and C, and 5,000 sq m costing 6,000,000 pesos for option B.

There are no special payment for rights of way, easements or rents, all of which have been included in the development price.

5.5 LOCAL CONDITIONS

The region to the south of Metro Manila is a rural coastal plain which has, until recent times been utilised for the production of sugar cane and similar crops in small and medium sized farms and plantations.

The region has a tropical maritime climate and is close to the Pacific Ocean and the South China sea. The prevailing winds have a high humidity, ranging from 71% in March to 85% in September. The rainfall and temperature are also both consistently high for most of the year, the rainfall averaging 300-400 cm every year and the temperatures from a January average of 25.5 degrees and 28.8 degrees celcius in May.

The area is very suitable for the proposed industrial development, living conditions for workers are good in the region, other similar plants have already located in the distict and the general level of public and private resources is good.

5.6 ENVIRONMENTAL IMPACT

The environmental impact of the proposed plant in the region is not likely to lead to any significant short or long term problems.

Extra waste water treatment is required and this has been anticipated in the plant costs.

The proposed location is ideal for the plant and there are already existing plants such as the Coca-Cola bottling facility which has a similar environmental profile.

SECTION 6

PROJECT ENGINEERING

6.1 PROJECT LAYOUTS

6.1.1 Data and alternatives

The data required for the completion of the proposed project engineering programme is summarised in Table 6.1.1.

Table 6.1.1 Summary Table

item	basis for design	reference
- production schedule	sales 1995-2010	Appendix 3-30
- supply programme	local cornsteep liquor, soya sugar and imported, chemicals	Appendices 4-1 to 4-3
- technology	strain imported from Panlabs, training/ technology from India	section 6.3
- equipment	mostly imported from Europe, USA and Japan.	section 6.4
- civil works	local contractors	section 6.5
- local conditions	assistance from University of Philippines /Ministry of Health	

6.1.2 Alternative Process Plant Designs (Layouts)

The scope of the project has been to provide information for a feasibility study to estimate the capital and operating costs for the following three options:-

Option A Production of Penicillin G, 6-APA and semi-synthetic penicillins in bulk, and manufacture of dosage forms

Option B Production of 6-APA, semi-synthetic penicillins in bulk and final dosage forms, from imported Penicillin G

Option C Production of Penicillin G and 6-APA only

These options have been defined by UNIDO (see Appendix 1-1) following the previous work undertaken in the Philippines as described in section 2.3

6.1.2.1 Alternatives for Penicillin Production

The scope for alternative layouts for the production of Penicillin and its related products is limited and such opportunities are summarised as follows:-

- The older plants sterilise the media batchwise as an alternative to the continous media preparation section proposed in the selected layout and as shown in flow diagram 1, (Appendix 6-1). The plant is operated on a continuous basis to make the best use of heat exchange to conserve energy.

- the optimum size of the fermenting vessels shown in flow diagram 3 (Appendix 6-1), is 100 cu m. Larger sizes increase technical risk in so far as scale-up is always a problem for biotecnology plants. Also larger fermenters require larger electrical resources and suffer greater losses in the event of electrical failure.

- there are several options available for the Penicillin extraction part of the plant summarised in flow diagram 4, but the classical centrifugal extractor has been selected here to obtain a 95% recovery of Penicillin. The decision to use this method is a technical one based on minimal technical risk. The extraction solvents could vary and the final selection would be subject to experimental trials. There is an alternative system available to recover penicillin from the broth which uses a decanter to remove mycelium without the use of a filter. In view of the varying nature of mycelia and broths, in particular their non-Newtonian characteristics, it is necessary to conduct experimental work to confirm exact selections.

6.1.2.2 Alternatives in 6-APA Production

Starting from penicillin G, 6-APA can be made by a chemical or a biological method. The biological route is the most modern approach and is selected for this study. The chemical route is obsolescent and no longer the preferred production method for this product.

6.1.2.3 Alternatives in Bulk Semi-Synthetic Production

As discussed in paragraph 4.1.4 in the supply section of this report, all the semi-synthetic products are made from 6-APA by chemical synthesis, usually in a sequence of several steps where two or more chemicals A and B are reacted together to form a third chemical C. Chemical C may then have to be reacted with D to form E and so on... until the sequence is completed. The more steps required in each synthesis open up extra possibilities of alternative routes to the final product. In other words a different route from A to D might be selected depending upon the cost or availability of a certain intermediate.

The method selected here has also been selected to simplify the use of process plant since a similar process with some identical raw materials can be used for both Amoxycillin and Ampicillin.

6.1.2.4 **Alternatives in the Production of Dosage Forms**

Relative to the other products, the manufacture of capsules and syrups in dosage form is a straighforward task requiring machines for mixing, filling and packing only and there is no real scope for alternative methods.

6.1.3 Description of Proposed Plant (layout)

The process flow diagrams for all stages of manufacture of options A, B and C are set out in Appendix 6-1 complete with relevant equipment lists. The main manufacturing plant for penicillin production is shown in flow diagrams 1 to 5, and for 6-APA on diagram 6. Typical plot plan lay-outs are found in Appendix 6-2, sheet 1, for Options A and C and sheet 2 for Option B.

Table 6.1.3 Flow Diagrams

Diagrams	
1	Media preparation
2	Additive preparation
3	Penicillin fermentation
4	Downstream (penilcillin) recovery
5	Penicillin purification
6	6-APA production - diagram 6 only
7	Dane salt preparation
8	Amoxcillin/Ampicillin production
9	Cloxacillin production
10	Dosage production

6.2 SCOPE OF PROJECT

6.2.1 General Description

The scope of the project is to present the design of the most modern plant system available to produce the specified chemicals in bulk and final form to internationally acceptable standards of quality and productivity.

Each process has been evaluated to ensure it is up to date, and the preliminary engineering design has been developed in sufficient detail to ensure that project costs - see Appendix 9-2 - are accurate to ±15%. The detailed engineering calculations are found in Volume 3 -Working Papers.

The accuracy of the capital and operating costs estimate should be comparable with the accuracies achieved by engineering contracting companies when bidding for new business.

The plant process adopted consists of a fermentation process operated batchwise in a series of 100 cubic metre vessels. This process manufactures bulk penicillin which can be used in its own right as an antibiotic or importantly, as an ingredient to produce 6-APA which is the key product used as the means of producing - theoretically at least - an unlimited number of other related antibiotics known as semi-synthetic penicillins.

From the technical standpoint, since there is no existing similar plant to be found in the Philippines, the plant design has, of necessity, been determined from experience gained elsewhere in the world. In practice the details of the commercial operation of the process are still a commercial secret. Hence the need to collaborate with technical partners as discussed in section 6.3 with the detailed design, supply and erection of the plant being carried out by a multinational contracting company. This is normal industry practice for the successful implementation of a project.

6.2.2 Penicillin Manufacturing Process

The classical method of producing Penicillin in bulk by fermentation has not varied since the product was first manufactured. No other method is available.

6.2.2.1 Fermentation

The method of fermentation has been understood by mankind for many thousands of years as it has always been an important process in the manufacture of foodstuffs such as bread, cheese and alcoholic wines and beers. All these examples are fermentation processes and they all make use of living micro-organisms, such as yeasts, which have the ability to achieve chemical changes to the substrate in the presence of oxygen whilst metabolising themselves.

6.2.2.2 Changes to strains caused through Mutation

As with all living organisms including cells, a supply of nutrient, oxygen and controlled conditions of temperature, humidity and pressure are a requirement for health. With the passage of time as cells grow, multiply and die, they also mutate. Variations in mutation are called "strains" and cell geneticists study mutational changes particularly if they improve the yield of a commercially important biological process such as in penicillin.

6.2.2.3 **Large-scale manufacture of Penicillin in Fermenters**
Please see flow diagram 3 in Appendix 6-1 which illustrates the process flow.

Penicillin G is manufactured in bulk using a biological process which consists of batches made in 100 cu m fermenters and supplied with compressed air and raw material (nutrient) feedstock.

Each fermenter consists of a vertical cylindrical vessel complete with a sterile air supply, a powerful agitator and the means of removing the heat evolved from the batch. Initially, three 100 cu m fermenters are needed until the year 2000 after which four are required to cater for the production schedule until the year 2010.

In this study, the selection of the fermenter size has been optimised to take into account the benefits of scale.

Prior to pumping the broth or medium into the fermenter to make-up the batch, both the medium and the empty fermenter have to be sterilised; please see flow diagram 1 for media preparation and flow diagram 2 for additive preparation. After cooling, the micro-organisms, specially prepared in the 10 cu m seed fermenters, are added to the 100 cu m fermenter and the air supply and the agitator started.

The duration of each fermentation is approximately nine days and during its course, extra nutrients are added as required and as shown in flow diagrams 2 and 3.

6.2.2.4 **Penicillin Extraction and Recovery**
At the end of the nine day fermentation period, the batch is discharged to a recovery section of the plant shown in diagram 4. After removal of the spent micro-organisms or mycelia in a rotary vacuum filter, the penicillin is recovered from the spent broth. The liquor is first acidified so the Penicillin can be extracted into a solvent, using a high speed centrifugal liquid-liquid extractor. The extractor ensures that 95% of the Penicillin is recovered from the mother liquor and that no product is lost through chemical attack.

The raffinate is further processed using an alkaline buffer solution and a further separation made to reduce the volume of the liquors. The Penicillin is then crystallised, carbon tre.ted and dried.

Unlike the fermentation process which is biological, the extraction process is a typical physical chemical operation.

6.2.2.5 **Care and Control of Fermentation and Extraction**

Although the fermentation process is now well known, unlike chemical processes, extra care has to be taken to control the temperature, pressure, pH as well as the oxygen and nutrient levels. Since the micro-organism is living, it receives oxygen from the air, nutrients from the broth and expires carbon dioxide. As a secondary product, the micro-organism excretes penicillin before it expires naturally.

The art of successful fermenter operation is to ensure the raw materials and energy are used to produce the maximum amount of penicillin G rather than being spent unusefully in other ways, for example in the production of unnecessary cell growth. In practice this is achieved by controlling the amount and type of nutrients supplied to the fermentation as well as the acurate control of the physical process.

Since the micro-organisms are living, they have a life cycle which ends in death but as all living cells, they have the ability to mutate. Premature cell death and/or mutation can occur, disastrously, during a production fermentation should, for example, the oxygen supply be interrupted due to an electrical failure. This would shut down the air compressors and agitators. Productivity is also lost if, during the fermentation, the batch is allowed to become contaminated with unwanted micro-organisms from air or water borne pollution. Consequently, great care has to be taken in the operation of the fermentation process.

6.2.3 **6-APA Manufacturing Process**

6-APA can be made from one of two alternative processes. The one selected here is the up-to-date biological process which uses an insoluble enzyme to cleave the penicillin G molecule.

This method is preferred to the alternative chemical process, and has been selected because it is the most modern and cost-effective. Please refer to Appendix 6-1, flow diagram 6. The process starts with the prior manufacture of the amidase enzyme resin from a separate fermentation using E-coli bacteria. The enzyme is then reacted with Penicillin G to produce 6-APA, in yields of up to 90% under controlled alkaline conditions. The enzyme is removed by filtration, a solvent added and the 6-APA recovered by filtration, evaporated, crystallised, filtered and dried. The enzyme is capable of re-use and the process yields a solution of sodium phenyl acetate as a by-product which can be used directly for the penicillin G process.

As mentioned previously, 6-APA is only used as an intermediate to produce, in this case, amoxycillin, ampicillin and amoxycillin. There is therefore no call for the material to be produced as a pharmaceutical and bulk production of a technical grade only is required.

The 6-APA process is no longer covered by important patents.

6.2.4 Bulk Semi-synthetic production

Production methods for semi-synthetic antibiotics from 6-APA shown on flow diagrams 7, 8 and 9 are all chemical. The method selected for ampicillin and amoxycillin is similar, as this has the advantage that the same equipment and plant and similar raw materials can be used for both products.

The first step is the manufacture of the dane salt corresponding to the appropriate amino acid which is then reacted chemically with an acid chloride to form a mixed anhydride. This in turn is reacted with 6-APA to form the semi-synthetic penicillin which can then be purified by crystallisation. The yields from 6-APA are in the range 85-90% and the dane salts are made from the corresponding amino acids in yields of 95-98%. Cloxacillin is produced from 6-APA by reacting with the acid chloride in a solvent at low temperature. The cloxacillin is extracted into a solvent, precipitated, centrifuged and dried. The yields are in the order of 80%.

6.2.5 Production of Dosage Forms

Please see flow diagram 10 for an outline of the required machinery for the production of semi-synthetics in dosage form. Standard equipment for mixing, filling and packing has been selected, the capacity for which has been based upon the forecasted requirement in the year 2010 rounded upwards, to a total of 10 tonnes per year, - 7 tonnes in capsules and 3 tonnes in syrups or powders. However, these amounts are still less than the output expected from the smallest commercially available filling and packing equipment and so there is future scope to extend the output of final dosage form threefold by working shifts, that is without any increase in capital costs, and/or to manufacture additional products including penicillin G in dosage form.

6.3 TECHNOLOGIES

6.3.1 Penicillin G

The process technology selected here to manufacture penicillin G follows a classical process which is indeed very similar to that used to make all bulk antibiotics.

The proposed design takes cognizance of all recent developments, in particular the use of an up to date strain and a proper understanding of the importance of scale and scale-up.

Particular features may be summarised as follows:-

- use of high productivity strain,
- Utilises the fed-batch fermentation process,
- Uses classical centrifugal extractors,
- Uses power from the city supply with stand-by electrical generation.

There are no important patents held for this process.

6.3.1.1 Strain Productivity

The productivity of the strain for Penicillin G is particularly important if the plant has to compete successfully in the international market place, hence it is of the utmost importance the plant is supplied with a high productivity strain. A low productivity strain would seriously hamper the end-user's ability to produce and therefore sell penicillins at an attractive price. Also, as the productivity level of the best strains is expected to increase by around, 10% per year, a strain development programme is also essential.

The increases in productivity obtained by improvements to stains also must be anticipated by the fermenter designer and plant operator as they both have to make allowances for the future, ensuring, for example, there is sufficient air and cooling to cater for future developments. This element of uncertainty is the main reason the calculations for the design capacity of the penicillin plant, although based on the planned sales have been increased by varying contingencies of 10 to 20%.

The ability of the micro-organisms to mutate can and is applied to the advantage of the plant operator. In world-wide terms, there may be say, thirty individual factories producing penicillin and not all use the same strain of micro-organism. Consequently, output at the end of the fermentation process varies according to the productivity of the strain in use. In practical terms, each fermentation factory has a constant need to supply fresh micro-organisms for each new fermentation and this need for small-scale production in the laboratory is combined with a small strain support programme which gives the opportunity of improving strains through random selection of superior micro-organisms.

6.3.1.2 **Effects of Higher Temperatures in Philippines**
An important technical consideration is the high ambient temperature and humidity found in the Philippines, because such conditions affect the operation of the plant in two important ways:-

- the main process operates at 25 degrees celcius and the refrigeration needed for cooling increases operating costs over those found in plants located in temperate regions of the world.

- high ambient temperature and humidity make perfect breeding conditions for all types of micro-organism and contamination from naturally occuring and unwanted micro-organisms, usually emanating from air or water borne pollution is expensive and difficult to remove and lowers productivity in the fermentation process. Again, this problem is not so severe in those areas in northern America and Europe where the processes were originally developed and subsequently exploited successfully.

6.3.2 **Technology for 6-APA, and Semi-Synthetics**

The technology used for 6-APA, and semi-synthetic penicillins is no longer protected by patents and follows standard international practice used in the manufacture of fine organic chemicals, dyestuffs, agricultural and photographic chemicals as well as bulk active pharmaceutical ingredients.

6.3.3 **Technology for Final Dosage Forms**

Final dosage materials are already produced in the Philippines and the main requirement for technology concerns the need for proper quality control.

6.3.4 **Acquisition of Technology**

All the above technologies have been selected as being in keeping with modern international production methods to enable the plant to produce its products competitively in both domestic and world markets.

6.3.4.1 **Technology Transfer - Problems**

Whilst all of the products have been made in Western countries for many years and the principles of production are now well known, there is still considerable commercial secrecy surrounding the method for producing them in bulk form. This applies especially to the biological process for Penicillin G, and because of this well known problem, it would be a considerable benefit to obtain appropriate help from another Penicillin producer willing to co-operate on this venture and assist in the transfer of technology. training, and who has experience with microbiological processes, such as strain development in the laboratory and pilot plant.

Consequently, preliminary enquiries have been made and two companies have offered to asist a new Philippine project. They are Hindustan Antibiotics Ltd of India, (Penicillin Manufacture) and Panlabs Incorporated of the (USA Strain Development). Both these companies have been selected as international leaders and are otherwise suitable for the Philippine project. Fees but no royalties are payable to either company and have been included in our cost estimates.

6.3.4.2 **Technology for Penicillin Manufacture**

The necessary technology to manufacture penicillin G has been offered by:-

Hindustan Antibiotics Ltd (a Government of India enterprise), Pimpri, Pune 411 018, India. Contact Mr A K Basu, Managing Director; telephone +91 212 86511, fax +91 212 82327 or by telex 0146-279.

Hindustan Antibiotics has produced Penicillin G since 1954. The US$ 900,000 cost of this technology has been included in the project cost estimates.

6.3.4.3 **Technology for Strain Development**

The second important technological key to the success of a future plant manufacturing Penicillin G is the need to have access to a high yielding strain. The most satisfactcry way of accomplishing this is to join the collective research project operated by the Panlabs Company of the USA and Taiwan. Panlabs can be contacted at:-

Panlabs Incorporated, 11804 North Creek Parkway South, Bothel, Washington 98011-8805 USA, telephone +1 206 487 8200, fax +1 206 487 3787.

Panlabs Incorporated is said to provide strains for 70% of the world's current Penicillin production.

The cost of this technology has been included in the project cost estimates; $US 500,000 in year one and $75,000 each year for five years to continue the strain development programme.

6.4 EQUIPMENT

6.4.1 Equipment List

The equipment required for this project has been summarised in Appendix 6-3 under the following headings:-

Table 6.4.1 Equipment List Summary

			Options A	Options B	Options C
1	Media preparation	Penicillin G	x		x
2	Additive preparation	ditto	x		x
3	Penicillin fermentation	ditto	x		x
4	Downstream recovery	ditto	x		x
5	Penicillin purification	ditto	x		x
6	6-APA production	6-APA	x	x	x
7	Semi-synthetics	bulk	x	x	
8	Dosage form	Pen/Semi-synth	x	x	
9	Utilities		x	x	x

The above equipment lists have been used as the basis for cost estimates for the three options A, B and C which are summarised in Table 6.4.2 and form part of the project estimates set out in Appendix 9-2.

6.4.2 Capital Cost of Machinery and Plant

Almost all the machinery and plant required for this project is of a specialised nature and has to be imported. Table 6.4.2 summarises the capital costs in US dollars for the three options:-

Table 6.4.2 Cost of Production Machinery and Plant (units in US$ x 1 000)

	option A	option B	option C
Media preparation	751.0	-	741.0
Additive preparation	283.4	-	283.4
Penicillin fermentation	2 596.2	-	2 596.2
Downstream recovery	660.4	-	660.4
Penicillin purification	946.8	-	946.8
6-APA production	299.3	299.3	299.3
Semi-synthetics	791.3	791.3	-
Dosage form	420.7	420.7	-
Totals	6 749.1	1 511.3	5 537.1

6.4.3 Equipment Characteristics

6.4.3.1 Penicillin Manufacture and Equipment

The manufacture of Penicillin for pharmaceutical use is a biotechnological process and requires high quality equipment manufactured from good materials of construction, usually stainless steel.

Fabrication must be to a high standard to permit sterile and pharmaceutical operations to take place in the following places:-

- media preparation for fermentation,
- fermentation,
- final purification of penicillin,
- preparation of final dosage forms,

The penicillin fermentation and recovery equipment is typical of large scale bulk chemical manufacturing plant.

The equipment for extraction and recovery consists of typically of reactors, pipework and pumps as used in medium scale bulk chemical production. The usual material of construction is also stainless steel.

All process control will be achieved using microprocessor control to international standards.

None of this equipment is manufactured in the Philippines.

6.4.3.2 6-APA Equipment and Semi-Synthetic Penicillin Equipment

The 6-APA and semi-synthetic penicillin processes utilise equipment similar to that specified for use in the fine chemical, dyestuff, and pharmaceutical industries to produce fine chemicals and intermediates in batches of up to 3 cu m. and is typical of medium sized fine chemical plants found elsewhere in the world.

The process plant and equipment required for both these sections is of a less specialised nature than the penicillin plant and consists of reactors, pumps, driers, centrifuges, and feeders. Most equipment is stainless steel, glassed steel or plastic constuction and is not made in the Philippines.

6.4.3.3 Final Dosage Forms

The dosage machinery is standard equipment in the industry for mixing, filling, and packaging small containers for dosage. Again, none of this equipment is made locally.

6.4.4 Equipment Supply

Almost all the process plant equipment and spare parts required for the process plant is not made in the Philippines and must be imported.

In a general sense, the equipment is manufactured from high quality and expensive materials of construction for example, stainless steel and is to the high finish required, for example to manufacture pharmaceutical products to "Good Manufacturing Standards" (GMP) or to ensure the fermentaton plant can be maintained in a sterile condition.

Whilst most of the equipment has quoted delivery schedules up to a maximum of six months, certain machines are highly specialised in design and expensive to manufacture and with a handful of competent manufacturers worldwide and hence up to nine months has been allowed for delivery of the following:-

- centrifugal compressors of 1MW capacity capable of providing a water and oil free supply of compressed air.
- sterile air filters capable of removing bacteria from the compressed air.
- the provision of a special design of spiral heaters to sterilse the media prior to fermentation.
- 250kW agitators with 10m shaft length.
- rotary vacuum filters for removal of mycelium.
- high speed centrifugal liquid-liquid extractors for penicillin recovery and purification by solvent extraction.

6.5 CIVIL ENGINEERING WORKS

6.5.1 Selected Site

The selected location in the Science Park (see Section 5.3.2) consists of a development providing a selection of 1 or 0.5 ha sites. The Developers are responsible for the following civil works:-

- land clearing and levelling,
- provision of local roads to the site,
- provision of all utilities, water, power, and telephones to, and treatment of waste water from, the site.

6.5.2 Data and Alternatives

The physical site layouts for options A and C - on the one hectare site and for option B on the half hectare site are shown in the diagrams in Appendix 6-2.

Table 6.5.2 summarises the site requirements for each of the options which consist of three types of industrial buildings and provision for offices, workshops and utilities. All of the buildings can be constructed by locally based contractors.

Table 6.5.2 Summary of Buildings and Civil Works

facility	type	option A sq m	option B sq m	option C sq m
fermentation	1	1 000	-	1 000
extraction	2	400	-	400
6-APA	2	400	400	400
pilot plant	2	100	-	100
laboratory	3	300	100	300
utilities	1	1 600	300	1 600
warehousing	1	400	400	400
offices	3	300	300	300

Type 1 buildings consist of uninsulated steel frame with clad walls and roof, concrete floor, access doors for heavy equipment, steel support frames for process equipment and standard electrical equipment.

Type 2 buildings as 1 above except explosion proof electrical equipment

Type 3 buildings are 2 or 3 storey buildings, insulated, brick or clad construction, steel framed, air conditioned, wc's, wash rooms, canteens, rest areas included.

6.5.3 Cost Estimates

All cost estimates are set out in Appendix 9-2.

SECTION 7

PLANT ORGANISATION AND OVERHEAD COSTS

7.1 COST CENTRES

Table 7.1 defines cost centres from the standpoint of management and engineering:-

Table 7.1 Cost Centres - for production purposes only

Option	Sub group
Penicillin production	media preparation, additive preparation, fermentation, recovery and purification,
6 APA production	—
Bulk semi-synthetic penicillin production	amoxycillin, cloxacillin, ampicillin
Final dosage production	syrups, capsules
Utilities	boilers, refrigeration, cooling towers, electrical supply and distribution, stand-by electrical generation, waste water treatment, solvent recovery.

7.2 OVERHEAD COSTS

Appendix 7-1 to 7-3 set out the factory, overhead and sales costs for options A, B and C.

SECTION 8

MANPOWER

8.1 INTRODUCTION

Various levels of technical and business trained personnel are required for all three options of this project, and as the technologies will be entirely new to the Philippines the need for good well trained technical personnel is of paramount importance.

8.1.1 Head Count

The head count for the three options is found in Appendix 7-1 to 7-3 and summarised in Table 8.1.1.

Table 8.1.1 Proposed Head Count - Summary

Grade	Option A	Option B	Option C
Senior Management	5	5	4
Departmental Managers	9	9	5
Direct Production Staff			
Penicillin and 6-APA	61	28	61
Bulk Semi-Synthesis	28	28	-
Final Dosage Forms	19	19	-
Laboratory and Engineering Staff	79	32	79
Administration Staff	34	34	34
Sales Personnel	40	40	1
Total	275	195	184

8.2 BIOTECHNOLOGY AND THE NEED FOR TRAINING

There is an important need especially for senior staff to have a good background in biotechnology and at least two university graduates with at least 10 years experience in similar roles are required.

Preferably the chief executive and certainly the Technical Director, Chief Engineer and ine Prodcuation Manager need to be trained and qualified in biochemical or chemical engineering and to have had experience of bulk manufacture of antibiotics. Since there are no existing bulk antibiotic factories in the Philippines, this will become a problem which might only be solved by employing an experienced foreigner for a period of say five years.

Also cooperation with an existing antibiotic producer such as Hindustan Antibiotics Ltd of Pune, India, is essential. Please see section 6.3.4.2 of this report for details of this company who have offered their services to train production and laboratory personnel.

A good relationship with the biotechnology facilities at the University of the Philippines at Los Banos is also required.

8.2.1 Pharmaceutical Engineering and Sales - Management Grades

Suitably trained people for pharmaceutical processing, engineering, sales and management already exist in the Philippines and can be recruited locally.

8.2.2 Technical Grades

Provision has been made with Hindustan Antibiotics Ltd for a technicians' training package to be held in India or the Philippines. Again such training is essential, and costs for laboratory and production personnel to receive on the job training have been allowed for this purpose.

An extensive programme of in-house training will also be required in order to train production staff and in this connection, the assistance of the University of the Philippines at Los Banos will be necessary.

8.3 LABOUR

All labour will be recruited locally and there will be job opportunities for male and female production, clerical and laboratory staff. A continuous education training programme should be instituted.

8.4 QUALIFICATION REQUIRED

Apart from the special needs to train people in biotechnology, Table 8.4 summarises the qualification required from the workforce as a whole.

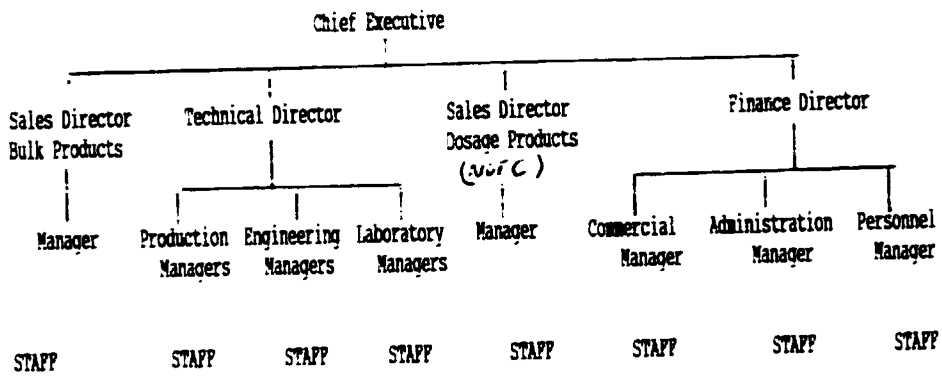
Table 8.4 Qualifications of Personnel

Grade/Post	School	Prior Experience Years
Chief Executive	Graduate	10 - 15
Directors	Graduate	10
Managers	Graduate	5 - 10
Technicians	Graduate or Diploma	5
Skilled Workers	Trained	5

8.5 **ORGANISATION CHARTS**

Figure 8.5 outlines the likely orgnaisation chart for all options.

Figure 8.5 Organisation Chart



8.6 **COSTS**

Please see Appendix 7-1 to 7-3 for details of salaries and employment costs.

SECTION 9

IMPLEMENTATION SCHEDULING

9.1 DATA AND ACTIVITIES

9.1.1 Options A and C of this project are really for medium sized bulk chemical and pharmaceutical products whilst option B is small to medium scale chemicals and pharmaceuticals, please see the bar chart which has been prepared (see Appendix 9-1) to provide a summary of the main actions required.

9.1.2 Following Philippine and international practice, the bar chart has been prepared under the following assumptions:-

- The plant will start up in 1995 and build up to full capacity starting in 1997
- The project will be placed with an engineering contractor for implementation to provide a 'turnkey' detailed design, supply and erection
- The contractor will be selected by open tender international before March 1993
- The contractor will be responsible for:-
  - any process licenses and process and plant guarantees
  - design, engineering, procurement, shipment, installation and commissioning
  - preparation of site
  - buildings and civil engineering design and construction
  - provision of utilities

9.2 SELECTION OF PROJECT IMPLEMENTATION SCHEDULE

9.2.1 A company will have to be formed during 1992/3 initially employing a skeleton staff of 2 or 3 persons to re-confirm the engineering, financial, marketing and technical proposals. This work should be completed by Spring 1993 at which time, contractors bids for the construction of the plant must be approved and land purchased.

9.2.2 Once the tender has been awarded, say by March 1992, the contractor will assume his main responsibilities fro construction but the new company will require the skeleton staff to monitor progress and to organise the recruitment and training of staff over the period 1994-5. The main site preparation and building work will be in 1992 ready for equipment installation during 1994. Commissioning of equipment will take place over the 1994-5 period.

9.3 PROJECT COST ESTIMATE

The preliminary engineering design has been developed in sufficient detail to ensure that project costs - see Appendix 9-2 - are accurate to ±15%. Please refer to this Appendix for a complete discussion and analysis of the project cost estimates.

SECTION 10

FINANCIAL EVALUATION : OPTION A

10.1 TOTAL INVESTMENT COSTS

10.1.1 Total Initial Investment Costs

10.1.1.1 The total initial investment cost of the proposed Option A has been estimated at P 1,657.5 million, equivalent to approximately US$ 63 75 million. 74% of this total would be payable in foreign currency :

Pesos '000	Foreign Currency	Local Currency	Total Cost
Initial Fixed Investment Costs	778,919	343,427	1,122,346
Pre-Production Capital Expenditure	388,594	22,589	411,183
Working Capital (at full capacity)	51,809	72,167	123,976
Total	1,219,322	438,183	1,657,505

10.1.1.2 Further details regarding the above cost estimates are presented in sections 10.1.2 to 10.1.4 inclusive.

10.1.2 Initial Fixed Investment Costs

10.1.2.1 The initial fixed investment cost of Option A may be broken down under five principal headings :

Pesos '000	Foreign Currency	Local Currency	Total Cost
Land	0	13,200	13,200
Site Preparation	0	7,150	7,150
Structures/Civil Works			
- Buildings and Civil Works	199,939	224,050	423,989
- Auxiliary and Service Facilities	0	30,925	30,925
Sub-Total	199,939	254,975	454,914
Incorporated Fixed Assets	55,876	0	55,876

Pesos '000	Foreign Currency	Local Currency	Total Cost
Machinery and Equipment			
- Production Machinery and Equipment	212,325	19,304	231,629
- Ancillary Production Equipment	171,983	16,380	188,363
- Auxiliary Equipment	138,796	12,618	151,414
- Vehicles	0	6,930	6,930
- Service Equipment	0	12,870	12,870
Sub-Total	523,104	68,102	591,206
Total	778,919	343,427	1,122,346

10.1.2.2 A detailed breakdown and explanation of the foregoing is presented at Appendix 10-1, but the following points may be highlighted for ease of reference :

a) The prices quoted for purchase of the factory site, project vehicles and office furniture and equipment have been based on information obtained in the Philippines.

b) The capital cost estimates in respect of site preparation and development, buildings and civil works, process licensing and the production and auxiliary machinery and equipment have been taken directly from the detailed project costing set out in Appendix 9-2, converted into Pesos.

c) Further provision has been made for payment of 10% customs duties on all imported items.

d) All the cost estimates are quoted inclusive of an overall 10% contingency allowance.

10.1.2.3 Although it is anticipated that the initial investment cost would be phased over three years, approximately 78% would be incurred in 1994, this being the second year of project implementation :

1993	:	P	174,648,000	=	15.6%
1994	:	P	879,609,000	=	78.4%
1995	:	P	68,089,000	=	6.0%
			P 1,122,346,000		

10.1.2.4 Further details in this regard are set out in Appendix 10-2, which also splits each of the estimates into its foreign and local currency cost components.

10.1.3 <u>Pre-Production Capital Expenditures</u>

10.1.3.1 The pre-production capital expenditures relating to Option A may also be broken down as follows :

Pesos '000	Foreign Currency	Local Currency	Total Cost
Pre-Investment Studies	8,580	0	8,580
Preparatory Engineering Studies	24,539	0	24,539
Management of Project Implementation	14,040	0	14,040
Detailed Engineering and Tendering	226,512	0	226,512
Supervision, Testing and Commissioning	71,796	8,835	80,631
Recruitment and Staff Training	7,800	1,300	9,100
Arrangements for Supplies	0	520	520
Arrangements for Marketing	0	2,080	2,080
Build-up of Connections	0	1,300	1,300
Capital Issue Expenses	0	6,500	6,500
Contingency Allowance	35,327	2,054	37,381
Total	388,594	22,589	411,183

10.1.3.2 The costs quoted in respect of the first five items specified have been taken directly from the detailed project costing set out in Appendix 9-2, converted into Pesos. The remaining expenditures have been estimated by reference to the information available, and separate provision has been made for an overall contingency allowance of 10%.

10.1.3.3 It is expected that all these costs would be incurred prior to the start-up of operations and would, in fact, be phased almost equally over the 2-year implementation phase :

1993	:	P 208,758,000	=	50.8%
1994	:	P 202,425,000	=	49.2%
		P 411,183,000		

10.1.3.4 Once again, further details in this regard are set out in Appendix 10-3, as is the split of the estimates into their foreign and local currency cost components.

10.1.4 Working Capital Requirement

10.1.4.1 The working capital requirements of the project for the 5-year operational period from 1995 to 1999 inclusive are presented in Appendix 10-4, together with details as to how these have been calculated. However, the total initial investment cost includes provision for the net working capital requirement in 1997, given that the proposed plant would then be operating at its maximum of 91% capacity utilisation :

Current Assets		
a) Accounts Receivable	:	P 30,811,000
b) Inventory		
- Local Materials	:	P 2,386,000
- Imported Materials	:	P 45,509,000
- Spare Parts	:	P 6,300,000
- Work-in-Progress	:	P 28,201,000
- Finished Products	:	P 29,870,000
b) Cash in Hand	:	P 5,629,000
Total Current Assets	:	P 148,706,000
Current Liabilities		
a) Accounts Payable	:	P 24,730,000
Net Working Capital	:	P 123,976,000

10.1.4.2 Based on the information set out in Appendices 10-2 to 10-4 inclusive, the investment costs incurred in each year of project implementation and operation from 1993 through to 1999 are summarised in Appendix 10-5 for ease of reference.

10.1.5 Total Assets Schedule

10.1.5.1 The initial asset value of Option A has been estimated at a total of just over P 1,682.2 million :

Pesos '000	Foreign Currency	Local Currency	Total Cost
Initial Fixed Investment Costs	778,919	343,427	1,122,346
Pre-Production Capital Expenditure	388,594	22,589	411,183
Current Assets (at full capacity)	51,809	96,897	148,706
Total	1,219,322	462,913	1,682,235

10.1.5.2 The build-up in the asset value in each year of project implementation and operation from 1993 through to 1999 is detailed in Appendix 10-6.

10.2 PROJECT FINANCING

10.2.1 Sources of Finance

10.2.1.1 The financing arrangements proposed for Option A are as follows :

Pesos '000	Foreign Currency	Local Currency	Total Cost
Equity Capital			
- Project Promoters	0	403,736	403,736
- Financial Agencies	269,158	0	269,158
Long-Term Borrowings			
- Foreign Currency	938,787	0	938,787
- Local Currency	0	45,824	45,824
Current Liabilities (at full capacity)	11,377	13,353	24,730
Total	1,219,322	462,913	1,682,235

10.2.1.2 The financing plan has been formulated by reference to five main assumptions :

a) The project would be required to conform to the standard guidelines set by the Central Bank of the Philippines with regard to suggested debt : equity ratios. Borrowings have therefore been limited to a maximum of 60% of the total requirement for project finance, the balance of 40% being covered by equity subscriptions by local promoters and external financial institutions or agencies.

b) It is anticipated that, whilst the involvement of the latter would be welcomed, the government would wish to ensure that the local project promoters retained an overall majority interest of 60%. The participation of external partners in the share capital has accordingly been limited to 40%.

c) 77% of the foreign currency investment in the initial assets of the project would be funded by medium term foreign currency loan facilities. These would bear interest at an average rate of 8% per annum, and would be repayable over six years (inclusive of a grace period of one year).

d) Just under 10% of the local currency investment in the initial assets of the project would be funded by Peso loan facilities. These would bear interest at an average rate of 25% per annum, and would be repayable over four years (inclusive of a grace period of one year).

e) The balance of the working capital requirement would be covered by the provision made for current liabilities (that is, accounts payable).

10.2.1.3 On the basis of the foregoing, the debt : equity ratio would amount to an acceptable 1.46 : 1 at the outset.

10.2.1.4 The initial financing plan for Option A is presented in Appendix 10-7, from which it may be noted that the prospective shareholders would be required to subscribe for their shares in full during 1993, the foreign currency loans would be drawndown in full by mid-1995 and the local currency loans would be drawndown in full by mid-1996. This would ensure that the project had sufficient funds to cover the anticipated expenditure on investment items, including working capital, during both the implementation phase and the build-up to full capacity utilisation in 1997.

10.2.1.5 Given the terms and conditions which have been assumed in respect of the foreign and local currency loans, and which are specified above, the annual financial costs may be estimated as follows :

Pesos '000	Forex Loan Facilities	Peso Loan Facilities	Total Interest
1995	75,103	0	75,013
1996	67,592	11,456	79,048
1997	52,572	9,547	62,119
1998	37,552	5,728	43,280
1999	22,531	1,909	24,440

10.3 PRODUCTION COSTS

10.3.1 Total Production Costs

10.3.1.1 Separate schedules summarising total production costs under their individual cost headings, and itemising these in detail, are set out in Appendix 10-8a and 8b respectively. Comprehensive notes on the assumptions used in compiling these figures are included therein, but a number of points may be highlighted for ease of reference :

a) Expenditures on raw material inputs and utilities have been calculated by reference to the detailed production schedule prepared, and specified usage and cost figures per individual input. In the case of imported materials, provision has been made for payment of 10% customs duties.

b) It is anticipated that Option A would employ a total of 108 direct production staff, and a further 79 laboratory and engineering staff.

c) In recognition of the fact that the extent and cost of servicing needs would increase over time, a 5% compound growth factor has been built into the provision made for importation of replacement spare parts.

d) Other factory overheads include provision for repairs and maintenance and expenditure on protective clothing and sundry consumable items (such as cleaning materials, lubricants, etc).

e) It is anticipated that Option A would employ a team of 10 senior managers, plus a further 34 administration and other personnel (including secretarial and clerical staff, storekeepers, security officers and drivers).

f) Administrative overheads include provisions in respect of the cost of insurance, office supplies, communications, land/property charges, licences, fees, travel/transport and sundry other items which are not separately specified, such as staff canteen and medical expenses.

g) Separate provision has been made for the cost of technology transfer in connection with the strain development programme for penicillin production.

h) It is anticipated that Option A would employ a total of 44 sales and distribution staff, both within the factory complex and in the field. The great majority of this number would be engaged in the marketing of final dosage forms.

i) Other sales and distribution costs include product promotion and advertising, travel and transport, office rental and sales commissions.

j) Full details of the financial costs assumed are set out in section 10.2.1.5 above.

k) Depreciation in respect of the proposed investment has been calculated on a straight line basis in accordance with the following rates :

Buildings and Civil Works	:	5%
Production and Auxiliary Equipment	:	5%
Vehicles	:	20%
Service Equipment	:	10%
Incorporated Fixed Assets and Pre-Production Capital Expenditures	:	20%

10.3.1.2 Total production costs in 1997, when the factory would be operating at its maximum capacity utilisation of 91%, may be summarised as follows :

Pesos '000	**Foreign Currency**	**Local Currency**	**Total Cost**
Direct Inputs			
- Raw Materials	136,526	85,913	222,439
- Utilities	0	74,324	74,324
Direct Manpower	0	10,180	10,180
Factory Overheads			
- Manpower	0	7,800	7,800
- Replacement Spares	12,599	0	12,599
- Other Overheads	0	11,064	11,064
Factory Costs	149,125	189,281	338,406
Admin. Overheads			
- Manpower	0	5,050	5,050
- Other Overheads	0	14,980	14,980
Sales/Distribution			
- Manpower	0	6,285	6,285
- Other Costs	0	5,014	5,014
Operating Costs	149,125	220,610	369,735
Financial Costs	52,572	9,547	62,119
Depreciation	0	147,400	147,400
Production Costs	201,697	377,557	579,254

10.3.2 **Unit Costs**

10.3.2.1 With regard to the unit costs of the various products to be manufactured in terms of Option A, these have been estimated on the basis of the cost of their direct inputs only and are as follows :

Penicillin			
- Raw Materials	:	P	636.30 per kg
- Utilities	:	P	268.70 per kg
Total Input Cost	:	P	905.00 per kg

6-APA		
- Penicillin	:	P 1,679.68 per kg
- Other Materials	:	P 231.27 per kg
- Utilities	:	P 5.45 per kg
Total Input Cost	:	P 1,916.40 per kg

Ampicillin		
- 6-APA	:	P 1,247.89 per kg
- Other Materials	:	P 651.74 per kg
- Utilities	:	P 81.50 per kg
Total Input Cost	:	P 1,981.13 per kg

Amoxycillin		
- 6-APA	:	P 1,235.18 per kg
- Other Materials	:	P 691.13 per kg
- Utilities	:	P 81.50 per kg
Total Input Cost	:	P 2,007.81 per kg

Cloxacillin		
- 6-APA	:	P 1,077.98 per kg
- Other Materials	:	P 763.44 per kg
- Utilities	:	P 48.20 per kg
Total Input Cost	:	P 1,889.62 per kg

10.3.2.2 Comparison of these unit costs with the anticipated maximum selling prices highlights the fact that, on the basis of the cost and market information available, the project would, in fact, be unable to charge prices for either Pen-G feedgrade or 6-APA which would cover their input costs alone. Both these products would therefore be produced at a gross loss, whilst the gross margins on all other products would range from 1% on ampicillin to a maximum (and acceptable) 34% on cloxacillin :

per kg	**Input Cost**	**Sales Price**	**Gross Margin**	**% Margin**
Pen-G (feedgrade)	905	650	(255)	(39%)
Pen-G (clinical)	905	1,300	395	30%
6-APA	1,916	1,794	(122)	(7%)
Ampicillin	1,981	2,002	21	1%
Amoxycillin	2,008	2,340	332	14%
Cloxacillin	1,890	2,860	970	34%

10.4 FINANCIAL EVALUATION

10.4.1 Financial Projections

10.4.1.1 The projected net income statement in respect of the operations of Option A over a 5-year period from 1995 to 1995 inclusive is presented at Appendix 10-9. The corresponding cash flow table for financial planning and the projected balance sheets for the project are set out in Appendices 10-10 and 10-11 respectively.

10.4.1.2 Attention may be drawn to three principal points in connection with these financial projections :

a) Option A would record an operating loss in each of the five years under review, due to the fact that input costs in respect of 6-APA in particular exceed the selling price assumed.

b) The accumulated losses would exceed the equity capital by the third year of operation, at which point the project would be technically bankrupt. By the end of the 5-year period, the accumulated losses would total nearly P 1,225 million, this being equivalent to approximately 75% of the total initial investment cost.

c) The cash deficit on operations alone would average nearly P 257 million per annum. By the end of the 5-year period, the cumulative cash shortfall would total over P 1,290 million.

10.4.1.3 For the sake of completeness, the key financial ratios for Option A once full capacity utilisation has been achieved (in 1997) are detailed below :

Simple Rate of Return		
- Total Investment	:	(11.6%)
- Equity Capital	:	(37.7%)
Break-Even Analysis		
- % Increase in Sales	:	1,134.2%
Debt : Equity Ratio		
- Including Cash Shortfall	:	2.0
Current Ratio	:	0.2
Debt Service Coverage Ratio	:	(0.4)

10.4.1.4 Appendix 10-12 details the cash flow tables in respect of both total investment and equity capital which form the basis for the internal rate of return analysis and computation of the net present value of the project :

Internal Rate of Return		
- Total Investment	:	(17.4%)
- Equity Capital	:	(32.4%)
Net Present Value @ 19%		
- Total Investment	:	(P 1,194.5 mn)
- Equity Capital	:	(P 925.2 mn)

10.4.2 **Sensitivity Analysis**

10.4.2.1 In order to assess the sensitivity of the project to those factors most likely to have a direct impact on profitability and cash flow, two alternative scenarios based on different revenue and cost assumptions were prepared. In each case, the object of the exercise was to ascertain what changes would be necessary to enable Option A to break-even by the end of the 5-year period under review :

Analysis I
Sales prices would have to increase by a minimum of 48% over and above the levels assumed.

Analysis II
The cost of all direct factory inputs, including raw materials, utilities, manpower and other factory overheads, would have to be reduced by not less than 50% from the levels assumed.

10.4.2.2 The results of both sensitivity analyses are summarised below for ease of reference :

		Analysis I	Analysis II
Simple Rate of Return			
- Total Investment	:	0.2%	0.7%
- Equity Capital	:	(3.2%)	(2.0%)
Break-Even Analysis			
- % of Sales in Year 5	:	98.6%	94.9%
Debt : Equity Ratio			
- Including Cash Shortfall	:	1.2	1.1
Current Ratio	:	0.2	0.2
Debt Service Coverage Ratio	:	0.6	0.6

10.4.2.3 With regard to the internal rate of return analysis, this was recalculated over a full 15-year period of operations in order to provide a more representative overview of the project :

		Analysis I	Analysis II
Internal Rate of Return			
- Total Investment	:	5.4%	6.7%
- Equity Capital	:	4.7%	6.3%
Net Present Value @ 19%			
- Total Investment	:	(P 850 mn)	(P 751 mn)
- Equity Capital	:	(P 637 mn)	(P 539 mn)

10.4.2.4 The foregoing serves to underline the fact that Option A would not be a feasible proposition, either under present-day circumstances, or in a situation where the underlying revenue and cost assumptions governing profitability could be dramatically improved. On this basis, the project should not be given further serious consideration.

SECTION 11

FINANCIAL EVALUATION : OPTION B

11.1 TOTAL INVESTMENT COSTS

11.1.1 Total Initial Investment Costs

11.1.1.1 The total initial investment cost of the proposed Option B has been estimated at P 632.5 million, equivalent to approximately US$ 24.33 million. 69% of this total would be payable in foreign currency :

Pesos '000	Foreign Currency	Local Currency	Total Cost
Initial Fixed Investment Costs	154,548	123,780	278,328
Pre-Production Capital Expenditure	206,094	19,008	225,102
Working Capital (at full capacity)	78,055	51,035	129,090
Total	438,697	193,823	632,520

11.1.1.2 Further details regarding the above cost estimates are presented in sections 11.1.2 to 11.1.4 inclusive.

11.1.2 Initial Fixed Investment Costs

11.1.2.1 The initial fixed investment cost of Option B may be broken down under five principal headings :

Pesos '000	Foreign Currency	Local Currency	Total Cost
Land	0	6,600	6,600
Site Preparation	0	2,145	2,145
Structures/Civil Works			
- Buildings and Civil Works	30,148	68,103	98,251
- Auxiliary and Service Facilities	0	18,590	18,590
Sub-Total	30,148	86,693	116,841
Incorporated Fixed Assets	856	0	856

Pesos '000	Foreign Currency	Local Currency	Total Cost
Machinery and Equipment			
- Production Machinery and Equipment	47,545	4,323	51,868
- Ancillary Production Equipment	39,541	3,765	43,306
- Auxiliary Equipment	36,458	3,314	39,772
- Vehicles	0	6,930	6,930
- Service Equipment	0	10,010	10,010
Sub-Total	123,544	28,342	151,886
Total	154,548	123,780	278,328

11.1.2.2 A detailed breakdown and explanation of the foregoing is presented at Appendix 11-1, but the following points may be highlighted for ease of reference :

a) The prices quoted for purchase of the factory site, project vehicles and office furniture and equipment have been based on information obtained in the Philippines.

b) The capital cost estimates in respect of site preparation and development, buildings and civil works, process licensing and the production and auxiliary machinery and equipment have been taken directly from the detailed project costing set out in Appendix 9-2, converted into Pesos.

c) Further provision has been made for payment of 10% customs duties on all imported items.

d) All the cost estimates are quoted inclusive of an overall 10% contingency allowance.

11.1.2.3 Although it is anticipated that the initial investment cost would be phased over three years, approximately 80% would be incurred in 1994, this being the second year of project implementation :

1993	:	P 46,642,000	=	16.8%
1994	:	P 221,919,000	=	79.7%
1995	:	P 9,767,000	=	3.5%
		P 278,328,000		

11.1.2.4 Further details in this regard are set out in Appendix 11-2, which also splits each of the estimates into its foreign and local currency cost components.

11.1.3 Pre-Production Capital Expenditures

11.1.3.1 The pre-production capital expenditures relating to Option B may also be broken down as follows :

Pesos '000	Foreign Currency	Local Currency	Total Cost
Pre-Investment Studies	4,290	0	4,290
Preparatory Engineering Studies	12,269	0	12,269
Management of Project Implementation	7,020	0	7,020
Detailed Engineering and Tendering	113,256	0	113,256
Supervision, Testing and Commissioning	42,723	5,580	48,303
Recruitment and Staff Training	7,800	1,300	9,100
Arrangements for Supplies	0	520	520
Arrangements for Marketing	0	2,080	2,080
Build-up of Connections	0	1,300	1,300
Capital Issue Expenses	0	6,500	6,500
Contingency Allowance	18,736	1,728	20,464
Total	206,094	19,008	225,102

11.1.3.2 The costs quoted in respect of the first five items specified have been taken directly from the detailed project costing set out in Appendix 6-**, converted into Pesos. The remaining expenditures have been estimated by reference to the information available, and separate provision has been made for an overall contingency allowance of 10%.

11.1.3.3 It is expected that all these costs would be incurred prior to the start-up of operations and would, in fact, be phased almost equally over the 2-year implementation phase :

1993	:	P 107,138,000	=	47.6%
1994	:	P 117,964,000	=	52.4%
		P 225,102,000		

11.1.3.4 Once again, further details in this regard are set out in Appendix 11-3, as is the split of the estimates into their foreign and local currency cost components.

11.1.4 **Working Capital Requirement**

11.1.4.1 The working capital requirements of the project for the 15-year operational period from 1995 to 2009 inclusive are presented in Appendix 11-4, together with details as to how these have been calculated. However, the total initial investment cost includes provision for the net working capital requirement in 1997, when the proposed plant would be operating at 70.5% capacity utilisation :

Current Assets		
a) Accounts Receivable	:	P 23,354,000
b) Inventory		
- Local Materials	:	P -
- Imported Materials	:	P 76,567,000
- Spare Parts	:	P 1,488,000
- Work-in-Progress	:	P 21,613,000
- Finished Products	:	P 22,447,000
b) Cash in Hand	:	P 3,142,000
Total Current Assets	:	P 148,611,000
Current Liabilities		
a) Accounts Payable	:	P 19,521,000
Net Working Capital	:	P 129,090,000

11.1.4.2 Based on the information set out in Appendices 11-2 to 11-4 inclusive, the investment costs incurred in each year of project implementation and operation from 1993 through to 2009 are summarised in Appendix 11-5 for ease of reference.

11.1.5 **Total Assets Schedule**

11.1.5.1 The initial asset value of Option B has been estimated at a total of just over P 652 million :

Pesos '000	**Foreign Currency**	**Local Currency**	**Total Cost**
Initial Fixed Investment Costs	154,548	123,780	278,328
Pre-Production Capital Expenditure	206,094	19,008	225,102
Current Assets (at full capacity)	78,055	70,556	148,611
Total	438,697	213,344	652,041

11.1.5.2 The build-up in the asset value in each year of project implementation and operation from 1993 through to 2009 is detailed in Appendix 11-6.

11.2 PROJECT FINANCING

11.2.1 Sources of Finance

11.2.1.1 The financing arrangements proposed for Option B are as follows :

Pesos '000	Foreign Currency	Local Currency	Total Cost
Equity Capital			
- Project Promoters	0	156,490	156,490
- Financial Agencies	104,326	0	104,326
Long-Term Borrowings			
- Foreign Currency	315,229	0	315,229
- Local Currency	0	56,475	56,475
Current Liabilities (at full capacity)	19,142	379	19,521
Total	438,697	213,344	652,041

11.2.1.2 The financing plan has been formulated by reference to five main assumptions :

a) The project would be required to conform to the standard guidelines set by the Central Bank of the Philippines with regard to suggested debt : equity ratios. Borrowings have therefore been limited to a maximum of 60% of the total requirement for project finance, the balance of 40% being covered by equity subscriptions by local promoters and external financial institutions or agencies.

b) It is anticipated that, whilst the involvement of the latter would be welcomed, the government would wish to ensure that the local project promoters retained an overall majority interest of 60%. The participation of external partners in the share capital has accordingly been limited to 40%.

c) 72% of the foreign currency investment in the initial assets of the project would be funded by medium term foreign currency loan facilities. These would bear interest at an average rate of 8% per annum, and would be repayable over six years (inclusive of a grace period of one year).

d) Just over 26% of the local currency investment in the initial assets of the project would be funded by Peso loan facilities. These would bear interest at an average rate of 25% per annum, and would be repayable over four years (inclusive of a grace period of one year).

e) The balance of the working capital requirement would be covered by the provision made for current liabilities (that is, accounts payable).

11.2.1.3 On the basis of the foregoing, the debt : equity ratio would amount to an acceptable 1.43 : 1 at the outset.

11.2.1.4 The initial financing plan for Option B is presented in Appendix 11-7, from which it may be noted that the prospective shareholders would be required to subscribe for their shares in full during 1993, the foreign currency loans would be drawndown in full by mid-1995 and the local currency loans would be drawndown in full by mid-1996. This would ensure that the project had sufficient funds to cover the anticipated expenditure on investment items, including working capital, during both the implementation phase and the build-up to 71% capacity utilisation in 1997.

11.2.1.5 Given the terms and conditions which have been assumed in respect of the foreign and local currency loans, and which are specified above, the annual financial costs may be estimated as follows :

Pesos '000	Forex Loan Facilities	Peso Loan Facilities	Total Interest
1995	25,218	0	25,218
1996	22,696	14,119	36,815
1997	17,652	11,765	29,417
1998	12,609	7,059	19,668
1999	7,566	2,353	9,919
2000	2,522	0	2,522

11.3 PRODUCTION COSTS

11.3.1 Total Production Costs

11.3.1.1 Separate schedules summarising total production costs under their individual cost headings, and itemising these in detail, are set out in Appendix 11-8a and 8b respectively. Comprehensive notes on the assumptions used in compiling these figures are included therein, but a number of points may be highlighted for ease of reference :

a) Expenditures on raw material inputs and utilities have been calculated by reference to the detailed production schedule prepared, and specified usage and cost figures per individual input. In the case of imported materials, provision has been made for payment of 10% customs duties.

b) It is anticipated that Option B would employ a total of 75 direct production staff, and a further 32 laboratory and engineering staff.

c) In recognition of the fact that the extent and cost of servicing needs would increase over time, a 5% compound growth factor has been built into the provision made for importation of replacement spare parts.

d) Other factory overheads include provision for repairs and maintenance and expenditure on protective clothing and sundry consumable items (such as cleaning materials, lubricants, etc).

e) It is anticipated that Option B would employ a team of 10 senior managers, plus a further 34 administration and other personnel (including secretarial and clerical staff, storekeepers, security officers and drivers).

f) Administrative overheads include provisions in respect of the cost of insurance, office supplies, communications, land/property charges, licences, fees, travel/transport and sundry other items which are not separately specified, such as staff canteen and medical expenses.

g) It is anticipated that Option B would employ a total of 44 sales and distribution staff, both within the factory complex and in the field. The great majority of this number would be engaged in the marketing of final dosage forms.

h) Other sales and distribution costs include product promotion and advertising, travel and transport, office rental and sales commissions.

i) Full details of the financial costs assumed are set out in section 11.2.1.5 above.

j) Depreciation in respect of the proposed investment has been calculated on a straight line basis in accordance with the following rates :

Buildings and Civil Works	:	5%
Production and Auxiliary Equipment	:	5%
Vehicles	:	20%
Service Equipment	:	10%
Incorporated Fixed Assets and Pre-Production Capital Expenditures	:	20%

11.3.1.2 Total production costs in 1997, when the factory would be operating at a capacity utilisation of 71%, may be summarised as follows :

Pesos '000	Foreign Currency	Local Currency	Total Cost
Direct Inputs			
- Raw Materials	229,701	0	229,701
- Utilities	0	4,549	4,549
Direct Manpower	0	7,540	7,540
Factory Overheads			
- Manpower	0	3,680	3,680
- Replacement Spares	2,976	0	2,976
- Other Overheads	0	10,907	10,907
Factory Costs	232,677	26,676	259,353
Admin. Overheads			
- Manpower	0	5,050	5,050
- Other Overheads	0	4,965	4,965
Sales/Distribution			
- Manpower	0	6,285	6,285
- Other Costs	0	4,594	4,594
Operating Costs	232,677	47,570	280,247
Financial Costs	17,652	11,765	29,417
Depreciation	0	60,168	60,168
Production Costs	250,329	119,503	369,832

11.3.2 **Unit Costs**

10.3.2.1 With regard to the unit costs of the various products to be manufactured in terms of Option B, these have been estimated on the basis of the cost of their direct inputs only and are as follows :

6-APA		
- Penicillin	:	P 1,198.58 per kg
- Other Materials	:	P 231.27 per kg
- Utilities	:	P 5.45 per kg
Total Input Cost	:	P 1,435.30 per kg

Ampicillin		
- 6-APA	:	P 934.61 per kg
- Other Materials	:	P 651.74 per kg
- Utilities	:	P 81.50 per kg
Total Input Cost	:	P 1,667.85 per kg

Amoxycillin		
- 6-APA	:	P 925.10 per kg
- Other Materials	:	P 691.13 per kg
- Utilities	:	P 81.50 per kg
Total Input Cost	:	P 1,697.73 per kg

Cloxacillin		
- 6-APA	:	P 807.36 per kg
- Other Materials	:	P 763.44 per kg
- Utilities	:	P 48.20 per kg
Total Input Cost	:	P 1,619.00 per kg

11.3.2.2 Comparison of these unit costs with the anticipated maximum selling prices highlights the fact that, on the basis of the cost and market information available, the gross margins on 6-APA and ampicillin would probably be unacceptably low at 20% and 17% respectively. Only amoxycillin and cloxacillin could be produced and sold at a reasonable gross profit in relation to their input cost, with margins of 27% and 43% respectively :

per kg	Input Cost	Sales Price	Gross Margin	% Margin
6-APA	1,435	1,794	359	20%
Ampicillin	1,668	2,002	334	17%
Amoxycillin	1,698	2,340	642	27%
Cloxacillin	1,619	2,860	1,241	43%

11.4 FINANCIAL EVALUATION

11.4.1 Financial Projections

11.4.1.1 The projected net income statement in respect of the operations of Option B over a 15-year period from 1995 to 2009 inclusive is presented at Appendix 11-9. The corresponding cash flow table for financial planning and the projected balance sheets for the project are set out in Appendices 11-10 and 11-11 respectively.

11.4.1.2 Attention may be drawn to a number of principal points in connection with these financial projections :

a) Option B would record a gross loss in each of the first five years of operation, the extent of which would steadily reduce in line with the increased production of the semi-synthetics in particular.

b) Thereafter, the overall increase in production would result in pre-tax profitability increasing steadily from a figure of P 50.8 million in the year 2000 to nearly P 90 million by 2009.

c) Net profits after tax would range from 9% in the year 2001 to a maximum of 11.5% by the end of the project period.

d) Accumulated losses would peak at just over P 250.4 million in 1999, and revenue reserves would only become positive six years later. However, by the end of the 15-year project period, accumulated profits would total nearly P 92.3 million.

e) The cumulative cash shortfall would peak at just over P 285.1 million in the year 2000. Given the reasonably strong positive cash flow thereafter, an overall cash surplus would be recorded as from 2006, and total cash balances would exceed P 92 million by the end of the project period.

f) The revenue and cash reserves of Option B would be such that 80% of profits after tax could be distributed as dividends as from the year 2007.

11.4.1.3 The key financial ratios for Option B when operating at approximate break-even and 71% capacity utilisation in 1999, and at 92% of capacity in 2005 are detailed below :

		1999	2005
Simple Rate of Return			
- Total Investment	:	(0.1%)	7.1%
- Equity Capital	:	(4.0%)	18.4%
Break-Even Analysis			
- % of Sales	:	100.5%	45.6%
Debt : Equity Ratio			
- Including Cash Shortfall	:	0.2	n/a
Current Ratio	:	0.5	2.9
Debt Service Coverage Ratio	:	0.5	n/a

11.4.1.4 Appendix 11-12 details the cash flow tables in respect of both total investment and equity capital which form the basis for the internal rate of return analysis and computation of the net present value of the project :

Internal Rate of Return		
- Total Investment	:	2.9%
- Equity Capital	:	1.7%

Net Present Value @ 19%		
- Total Investment	:	(P 342.9 mn)
- Equity Capital	:	(P 277.5 mn)
Net Present Value @ 15%		
- Total Investment	:	(P 313.0 mn)
- Equity Capital	:	(P 266.9 mn)
Pay-Back Period	:	13.5 years

11.4.2 <u>**Sensitivity Analysis**</u>

11.4.2.1 In order to assess the sensitivity of the project to those factors most likely to have a direct impact on profitability and cash flow, two alternative scenarios based on different revenue and cost assumptions were prepared. In each case, the object of the exercise was to ascertain what changes would be necessary to enable Option B to achieve an internal rate of return on total investment of 19% :

Analysis I
Sales prices would have to increase by a minimum of 31% over and above the levels assumed.

Analysis II
The cost of all direct factory inputs, including raw materials, utilities, manpower and other factory overheads, would have to be reduced by not less than 34% from the levels assumed.

11.4.2.2 The results of both sensitivity analyses are summarised below for ease of reference (for comparative purposes, it may be noted that all figures relate to 1999) :

		Analysis I	Analysis II
Simple Rate of Return			
- Total Investment	:	16.5%	15.7%
- Equity Capital	:	36.8%	34.5%
Break-Even Analysis			
- % of Sales	:	50.1%	50.5%
Debt : Equity Ratio			
- Including Cash Shortfall	:	0.2	0.3
Current Ratio	:	15.2	18.6
Debt Service Coverage Ratio	:	1.7	1.6

11.4.2.3 With regard to the internal rate of return analysis, and the calculation of the net present value of the project, these may be summarised as follows :

		Analysis I	Analysis II
Internal Rate of Return			
- Total Investment	:	19.1%	19.0%
- Equity Capital	:	23.1%	22.4%
Net Present Value @ 19%			
- Total Investment	:	P 2 mn	P 1 mn
- Equity Capital	:	P 67 mn	P 51 mn
Net Present Value @ 15%			
- Total Investment	:	P 121 mn	P 113 mn
- Equity Capital	:	P 167 mn	P 141 mn
Pay-Back Period	:	5.5 years	5.5 years

11.4.2.4 On the basis of the foregoing, Option B could only be considered a feasible proposition in circumstances whereby either :

a) the underlying revenue and/or cost assumptions governing profitability could be improved; or

b) Considerably greater emphasis could be given to the in-house production of semi-synthetics, in order to reduce the volume of 6-APA offered for sale at what is undoubtedly an unattractive gross margin over input costs.

11.4.2.5 However, success in this latter regard would depend upon the project being able to secure a larger share in what are already strongly competitive markets, and the potential for this is in some doubt (please refer to sections 3.4.3.3 and 3.4.3.4 dealing with market penetration).

11.4.2.6 Looked at realistically, it may therefore be concluded that the chances for the successful implementation and operation of Option B would be marginal at best.

SECTION 12

FINANCIAL EVALUATION : OPTION C

12.1 **TOTAL INVESTMENT COSTS**

12.1.1 **Total Initial Investment Costs**

12.1.1.1 The total initial investment cost of the proposed Option C has been estimated at P 1,462.9 million, equivalent to approximately US$ 56.3 million. 74% of this total would be payable in foreign currency :

Pesos '000	Foreign Currency	Local Currency	Total Cost
Initial Fixed Investment Costs	698,152	299,442	997,594
Pre-Production Capital Expenditure	338,490	22,383	360,873
Working Capital (at full capacity)	41,757	62,643	104,400
Total	1,078,399	384,468	1,462,867

12.1.1.2 Further details regarding the above cost estimates are presented in sections 12.1.2 to 12.1.4 inclusive.

12.1.2 **Initial Fixed Investment Costs**

12.1.2.1 The initial fixed investment cost of Option C may be broken down under five principal headings :

Pesos '000	Foreign Currency	Local Currency	Total Cost
Land	0	13,200	13,200
Site Preparation	0	7,150	7,150
Structures/Civil Works			
- Buildings and Civil Works	176,322	189,771	366,093
- Auxiliary and Service Facilities	0	29,853	29,853
Sub-Total	176,322	219,624	395,946
Incorporated Fixed Assets	55,876	0	55,876

Pesos '000	Foreign Currency	Local Currency	Total Cost
Machinery and Equipment			
- Production Machinery and Equipment	174,194	15,837	190,031
- Ancillary Production Equipment	152,964	14,568	167,532
- Auxiliary Equipment	138,796	12,618	151,414
- Vehicles	0	4,290	4,290
- Service Equipment	0	12,155	12,155
Sub-Total	465,954	59,468	525,422
Total	698,152	299,442	997,594

12.1.2.2 A detailed breakdown and explanation of the foregoing is presented at Appendix 12-1, but the following points may be highlighted for ease of reference :

a) The prices quoted for purchase of the factory site, project vehicles and office furniture and equipment have been based on information obtained in the Philippines.

b) The capital cost estimates in respect of site preparation and development, buildings and civil works, process licensing and the production and auxiliary machinery and equipment have been taken directly from the detailed project costing set out in Appendix 6-**, converted into Pesos.

c) Further provision has been made for payment of 10% customs duties on all imported items.

d) All the cost estimates are quoted inclusive of an overall 10% contingency allowance.

12.1.2.3 Although it is anticipated that the initial investment cost would be phased over three years, approximately 78% would be incurred in 1994, this being the second year of project implementation :

1993	:	P 153,492,000	=	15.4%
1994	:	P 781,213,000	=	78.3%
1995	:	P 62,889,000	=	6.3%
		P 997,594,000		

12.1.2.4 Further details in this regard are set out in Appendix 12-2, which also splits each of the estimates into its foreign and local currency cost components.

12.1.3 Pre-Production Capital Expenditures

12.1.3.1 The pre-production capital expenditures relating to Option C may also be broken down as follows :

Pesos '000	Foreign Currency	Local Currency	Total Cost
Pre-Investment Studies	8,580	0	8,580
Preparatory Engineering Studies	20,449	0	20,449
Management of Project Implementation	14,040	0	14,040
Detailed Engineering and Tendering	188,760	0	188,760
Supervision, Testing and Commissioning	68,089	8,648	76,737
Recruitment and Staff Training	7,800	1,300	9,100
Arrangements for Supplies	0	520	520
Arrangements for Marketing	0	2,080	2,080
Build-up of Connections	0	1,300	1,300
Capital Issue Expenses	0	6,500	6,500
Contingency Allowance	30,772	2,035	32,807
Total	338,490	22,383	360,873

12.1.3.2 The costs quoted in respect of the first five items specified have been taken directly from the detailed project costing set out in Appendix 9-2, converted into Pesos. The remaining expenditures have been estimated by reference to the information available, and separate provision has been made for an overall contingency allowance of 10%.

12.1.3.3 It is expected that all these costs would be incurred prior to the start-up of operations and would, in fact, be phased almost equally over the 2-year implementation phase :

1993	:	P 178,487,000	=	49.5%
1994	:	P 182,386,000	=	50.5%
		P 360,873,000		

12.1.3.4 Once again, further details in this regard are set out in Appendix 12-3, as is the split of the estimates into their foreign and local currency cost components.

12.1.4 Working Capital Requirement

12.1.4.1 The working capital requirements of the project for the 5-year operational period from 1995 to 1999 inclusive are presented in Appendix 12-4, together with details as to how these have been calculated. However, the total initial investment cost includes provision for the net working capital requirement in 1997, given that the proposed plant would then be operating at its maximum of 91% capacity utilisation :

Current Assets		
a) Accounts Receivable	:	P 26,527,000
b) Inventory		
- Local Materials	:	P 2,386,000
- Imported Materials	:	P 36,145,000
- Spare Parts	:	P 5,612,000
- Work-in-Progress	:	P 24,898,000
- Finished Products	:	P 26,417,000
b) Cash in Hand	:	P 4,489,000
Total Current Assets	:	P 126,474,000
Current Liabilities		
a) Accounts Payable	:	P 22,074,000
Net Working Capital	:	P 104,400,000

12.1.4.2 Based on the information set out in Appendices 12-2 to 12-4 inclusive, the investment costs incurred in each year of project implementation and operation from 1993 through to 1999 are summarised in Appendix 12-5 for ease of reference.

12.1.5 Total Assets Schedule

12.1.5.1 The initial asset value of Option C has been estimated at a total of just over P 1,484.9 million :

Pesos '000	**Foreign Currency**	**Local Currency**	**Total Cost**
Initial Fixed Investment Costs	698,152	299,442	997,594
Pre-Production Capital Expenditure	338,490	22,383	360,873
Current Assets (at full capacity)	41,757	84,717	126,474
Total	1,078,399	406,542	1,484,941

12.1.5.2 The build-up in the asset value in each year of project implementation and operation from 1993 through to 1999 is detailed in Appendix 12-6.

12.2 PROJECT FINANCING

12.2.1 Sources of Finance

12.2.1.1 The financing arrangements proposed for Option C are as follows :

Pesos '000	Foreign Currency	Local Currency	Total Cost
Equity Capital			
- Project Promoters	0	356,386	356,386
- Financial Agencies	237,590	0	237,590
Long-Term Borrowings			
- Foreign Currency	831,773	0	831,773
- Local Currency	0	37,118	37,118
Current Liabilities (at full capacity)	9,036	13,038	22,074
Total	1,078,399	406,542	1,484,941

12.2.1.2 The financing plan has been formulated by reference to five main assumptions :

a) The project would be required to conform to the standard guidelines set by the Central Bank of the Philippines with regard to suggested debt : equity ratios. Borrowings have therefore been limited to a maximum of 60% of the total requirement for project finance, the balance of 40% being covered by equity subscriptions by local promoters and external financial institutions or agencies.

b) It is anticipated that, whilst the involvement of the latter would be welcomed, the government would wish to ensure that the local project promoters retained an overall majority interest of 60%. The participation of external partners in the share capital has accordingly been limited to 40%.

c) 77% of the foreign currency investment in the initial assets of the project would be funded by medium term foreign currency loan facilities. These would bear interest at an average rate of 8% per annum, and would be repayable over six years (inclusive of a grace period of one year).

d) Just under 10% of the local currency investment in the initial assets of the project would be funded by Peso loan facilities. These would bear interest at an average rate of 25% per annum, and would be repayable over four years (inclusive of a grace period of one year).

e) The balance of the working capital requirement would be covered by the provision made for current liabilities (that is, accounts payable).

12.2.1.3 On the basis of the foregoing, the debt : equity ratio would amount to an acceptable 1.46 : 1 at the outset.

12.2.1.4 The initial financing plan for Option A is presented in Appendix 12-7, from which it may be noted that the prospective shareholders would be required to subscribe for their shares in full during 1993, the foreign currency loans would be drawndown in full by mid-1995 and the local currency loans would be drawndown in full by mid-1996. This would ensure that the project had sufficient funds to cover the anticipated expenditure on investment items, including working capital, during both the implementation phase and the build-up to full capacity utilisation in 1997.

12.2.1.5 Given the terms and conditions which have been assumed in respect of the foreign and local currency loans, and which are specified above, the annual financial costs may be estimated as follows :

Pesos '000	Forex Loan Facilities	Peso Loan Facilities	Total Interest
1995	66,542	0	66,542
1996	59,888	9,280	69,168
1997	46,580	7,733	54,313
1998	33,271	4,640	37,911
1999	19,962	1,547	21,509

12.3 PRODUCTION COSTS

12.3.1 Total Production Costs

12.3.1.1 Separate schedules summarising total production costs under their individual cost headings, and itemising these in detail, are set out in Appendix 12-8a and 8b respectively. Comprehensive notes on the assumptions used in compiling these figures are included therein, but a number of points may be highlighted for ease of reference :

a) Expenditures on raw material inputs and utilities have been calculated by reference to the detailed production schedule prepared, and specified usage and cost figures per individual input. In the case of imported materials, provision has been made for payment of 10% customs duties.

b) It is anticipated that Option C would employ a total of 61 direct production staff, and a further 79 laboratory and engineering staff.

c) In recognition of the fact that the extent and cost of servicing needs would increase over time, a 5% compound growth factor has been built into the provision made for importation of replacement spare parts.

d) Other factory overheads include provision for repairs and maintenance and expenditure on protective clothing and sundry consumable items (such as cleaning materials, lubricants, etc).

e) It is anticipated that Option C would employ a team of 8 senior managers, plus a further 34 administration and other personnel (including secretarial and clerical staff, storekeepers, security officers and drivers).

f) Administrative overheads include provisions in respect of the cost of insurance, office supplies, communications, land/property charges, licences, fees, travel/transport and sundry other items which are not separately specified, such as staff canteen and medical expenses.

g) Separate provision has been made for the cost of technology transfer in connection with the strain development programme for penicillin production.

h) It is anticipated that Option C would employ only two sales staff within the factory complex.

i) Other sales and distribution costs include product promotion and advertising, travel and transport.

j) Full details of the financial costs assumed are set out in section 12.2.1.5 above.

k) Depreciation in respect of the proposed investment has been calculated on a straight line basis in accordance with the following rates :

Buildings and Civil Works	:	5%
Production and Auxiliary Equipment	:	5%
Vehicles	:	20%
Service Equipment	:	10%
Incorporated Fixed Assets and Pre-Production Capital Expenditures	:	20%

12.3.1.2 Total production costs in 1997, when the factory would be operating at its maximum capacity utilisation of 91%, may be summarised as follows :

Pesos '000	Foreign Currency	Local Currency	Total Cost
Direct Inputs			
- Raw Materials	108,434	85,913	194,347
- Utilities	0	70,543	70,543
Direct Manpower	0	5,840	5,840
Factory Overheads			
- Manpower	0	7,800	7,800
- Replacement Spares	11,223	0	11,223
- Other Overheads	0	9,024	9,024
Factory Costs	119,657	179,120	298,777
Admin. Overheads			
- Manpower	0	4,550	4,550
- Other Overheads	0	13,681	13,681
Sales/Distribution			
- Manpower	0	680	680
- Other Costs	0	635	635
Operating Costs	119,657	198,666	318,323
Financial Costs	46,580	7,733	54,313
Depreciation	0	130,672	130,672
Production Costs	166,237	337,071	503,308

12.3.2 <u>Unit Costs</u>

12.3.2.1 With regard to the unit costs of the various products to be manufactured in terms of Option A, these have been estimated on the basis of the cost of their direct inputs only and are as follows :

Penicillin		
- Raw Materials	:	P 636.30 per kg
- Utilities	:	P 268.70 per kg
Total Input Cost	:	P 905.00 per kg
6-APA		
- Penicillin	:	P 1,679.68 per kg
- Other Materials	:	P 231.27 per kg
- Utilities	:	P 5.45 per kg
Total Input Cost	:	P 1,916.40 per kg

12.3.2.2 Comparison of these unit costs with the anticipated maximum selling prices highlights the fact that, on the basis of the cost and market information available, the project would, in fact, be unable to charge prices for either Pen-G feedgrade or 6-APA which would cover their input costs alone. Both these products would therefore be produced at a gross loss, as against an acceptable 30% gross margin on clinical grades of Pen-G :

per kg	Input Cost	Sales Price	Gross Margin	% Margin
Pen-G (feedgrade)	905	650	(255)	(39%)
Pen-G (clinical)	905	1,300	395	30%
6-APA	1,916	1,794	(122)	(7%)

12.4 FINANCIAL EVALUATION

12.4.1 Financial Projections

12.4.1.1 The projected net income statement in respect of the operations of Option C over a 5-year period from 1995 to 1995 inclusive is presented at Appendix 12-9. The corresponding cash flow table for financial planning and the projected balance sheets for the project are set out in Appendices 12-10 and 12-11 respectively.

12.4.1.2 Attention may be drawn to three principal points in connection with these financial projections :

a) Option C would record an operating loss in each of the five years under review, due to the fact that input costs in respect of two out of three products exceed the selling price assumed.

b) The accumulated losses would exceed the equity capital by the third year of operation, at which point the project would be technically bankrupt. By the end of the 5-year period, the accumulated losses would total nearly P 1,191 million, this being equivalent to approximately 81% of the total initial investment cost.

c) The cash deficit on operations alone would average nearly P 247 million per annum. By the end of the 5-year period, the cumulative cash shortfall would total over P 1,238 million.

12.4.1.3 For the sake of completeness, the key financial ratios for Option C once full capacity utilisation has been achieved (in 1997) are detailed below :

Simple Rate of Return		
- Total Investment	:	(13.1%)
- Equity Capital	:	(41.4%)
Break-Even Analysis		
- % Increase in Sales	:	1,344.2%
Debt : Equity Ratio		
- Including Cash Shortfall	:	2.1
Current Ratio	:	0.2
Debt Service Coverage Ratio	:	(0.5)

12.4.1.4 Appendix 12-12 details the cash flow tables in respect of both total investment and equity capital which form the basis for the internal rate of return analysis and computation of the net present value of the project :

Internal Rate of Return		
- Total Investment	:	(19.6%)
- Equity Capital	:	(36.5%)
Net Present Value @ 19%		
- Total Investment	:	(P 1,099.4 mn)
- Equity Capital	:	(P 862.9 mn)

12.4.2 **Sensitivity Analysis**

12.4.2.1 In order to assess the sensitivity of the project to those factors most likely to have a direct impact on profitability and cash flow, two alternative scenarios based on different revenue and cost assumptions were prepared. In each case, the object of the exercise was to ascertain what changes would be necessary to enable Option C to break-even by the end of the 5-year period under review :

Analysis I
Sales prices would have to increase by a minimum of 75% over and above the levels assumed.

Analysis II
The cost of all direct factory inputs, including raw materials, utilities, manpower and other factory overheads, would have to be reduced by not less than 62% from the levels assumed.

12.4.2.2 The results of both sensitivity analyses are summarised below for ease of reference :

		Analysis I	Analysis II
Simple Rate of Return			
- Total Investment	:	0.3%	0.1%
- Equity Capital	:	(2.8%)	(3.8%)
Break-Even Analysis			
- % of Sales in Year 5	:	97.5%	100.8%
Debt : Equity Ratio			
- Including Cash Shortfall	:	1.0	1.0
Current Ratio	:	0.3	0.1
Debt Service Coverage Ratio	:	0.6	0.6

12.4.2.3 With regard to the internal rate of return analysis, this was recalculated over a full 15-year period of operations in order to provide a more representative overview of the project :

		Analysis I	Analysis II
Internal Rate of Return			
- Total Investment	:	6.1%	6.4%
- Equity Capital	:	5.6%	5.9%
Net Present Value @ 19%			
- Total Investment	:	(P 687 mn)	(P 651 mn)
- Equity Capital	:	(P 500 mn)	(P 460 mn)

12.4.2.4 The foregoing serves to underline the fact that Option C would not be a feasible proposition, either under present-day circumstances, or in a situation where the underlying revenue and cost assumptions governing profitability could be dramatically improved. On this basis, the project should not be given further serious consideration.

SECTION 13

ECONOMIC ANALYSIS

13.1 ASSESSMENT OF OPTIONS

13.1.1 Option A

13.1.1.1 Option A comprises a fully integrated option covering all four stages in the manufacturing process, from the initial fermentation of penicillin, through to the production of the basic feedstock material 6-APA, and to production of a range of semi-synthetic penicillins in both bulk and final dosage form.

13.1.1.2 On the basis of the financial evaluation of Option A presented in Section 10, it is considered that this would not be a feasible proposition in that the project would be unable to produce either penicillin or 6-APA at a competitive ex-factory price relative to imports. The sensitivity analyses undertaken confirmed that, even with a 48% increase in sales price or a 50% reduction in the cost of all direct factory inputs, Option A would do no better than break-even after a five-year operational period.

13.1.2 Option B

13.1.2.1 Option B would leave out the process of fermentation, but would include all other stages in the manufacturing process based on the importation of Pen-G in bulk.

13.1.2.2 On the basis of the financial evaluation of Option B presented in Section 11, it is considered that the successful implementation and operation of this project would be dependent upon a combination of three factors in particular :

- an increase in ex-factory prices;
- a reduction in input costs; and
- an increase in the proportion of 6-APA processed into semi-synthetic penicillins at a higher value added to the project.

13.1.2.3 In view of the extent of existing competition in the domestic market for semi-synthetics, coupled with the fact that sales prices and input costs are effectively determined by international market conditions, the prospects for Option B would appear to be no better than marginal.

13.1.3 **Option C**

13.1.3.1 Option C would concentrate on the first two stages in the manufacturing process, the initial fermentation of penicillin and the production of 6-APA for sale in bulk.

13.1.3.2 On the basis of the financial evaluation of Option C presented in Section 12, it is considered that this proposition would be the least feasible of all three. The sensitivity analyses undertaken confirmed that sales prices would have to increase by 75%, or direct factory inputs would have to reduce by 62%, for Option C to do no better than break-even after a five-year operational period.

13.2 ECONOMIC ANALYSIS

Given the non-viability of the project proposals, a detailed economic analysis was deemed inappropriate. For the sake of completeness, however, the following sections outline the impact of Option B in terms of total employment and the utilisation of domestic resources.

13.2.1 **Employment**

13.2.1.1 It is anticipated that Option B would employ a total of 195 members of staff, broken down as follows :

Senior Management	:	5
Management	:	9
Direct Production Staff	:	75
Laboratory/Engineering Staff	:	32
Administration/Other Personnel	:	34
Sales Personnel	:	40
		195

13.2.1.2 The total wage and salary cost has been estimated at approximately P 22.6 million per annum, broken down as follows :

Senior Management	:	P 2,800,000
Management	:	P 2,250,000
Direct Production Staff	:	P 7,540,000
Laboratory/Engineering Staff	:	P 3,680,000
Administration/Other Personnel	:	P 1,500,000
Sales Personnel	:	P 4,785,000
		P 22,555,000

13.2.2 Domestic Resources

13.2.2.1 Option B would be entirely dependent upon imported raw material inputs, given that none of the chemicals used in the production process for either 6-APA or the semi-synthetic penicillins could be obtained from domestic sources of supply.

13.2.2.2 Utilisation of domestic resources would thus be limited to utilities and to such consumable items as protective clothing, cleaning materials, office supplies and the like. Total expenditure on these has been estimated as follows (in Pesos '000) :

	1995	1999	2004	2009
Utilities	2,076	6,389	7,769	9,372
Consumables	1,300	1,300	1,300	1,300
Office Supplies	650	650	650	650
	4,026	8,339	9,719	11,322

13.2.2.3 In addition, the investment cost estimates assume that all the project vehicles, the office furniture and equipment and the canteen and medical facilities would be purchased from domestic suppliers. Provision has therefore been made for replacement investment during the operational period as follows (in Pesos '000) :

	2000	2005
Vehicles	6,930	6,930
Service Equipment	-	10,010
	6,930	16,940

PREFEASIBILITY STUDY

ON

THE ESTABLISHMENT OF AN INDUSTRIAL SCALE PENICILLIN PLANT

PROJECT NO DG/PHI/86/014
CONTRACT NO 91/80

on behalf of

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION
PO BOX 300
A-1400 VIENNA
AUSTRIA

FEBRUARY 1992

Manderstam Consulting Services
2/10 Harbour Yard
Chelsea Harbour
London SW10 0XD

Tel: 071 730 9224
Fax: 071 823 3056
Tlx: 24787 Mander G

THE ESTABLISHMENT OF AN INDUSTRIAL SCALE PENICILLIN PLANT

PREFEASIBILITY STUDY - VOLUME II

LIST OF APPENDICES

7 November 1990

APPENDIX 1-1

ANNEX A

Terms of Reference (TOR) for the Pre-feasibility Study on the Establishment of an Industrial Scale Penicillin Fermentation Plant

I. BACKGROUND

The drug industry in the Philippines is largely a formulating and packaging industry. It is dependent on imports for all of its raw material requirements.

Among the most vital and strategic products of this industry are antibiotics whose raw materials are penicillin and semi-synthetic penicillins. In 1987, the Philippines imported an aggregate value of 117 tons of penicillin and semi-synthetic penicillins alone will rise to 168 tons by 1995. The continuous and increasing demand for antibiotics necessitates an initial effort toward self-sufficiency in the production of pharmaceuticals.

Semi-synthetic penicillin from imported 6-Amino-penicillanic Acid (6-APA) is being presently produced by a local pharmaceutical company, Chemfields, which begun operations in 1981. From an initial production volume of 25 metric tons its production increased to 75 metric tons in 1988. In 1982, this local company was granted protection by the Government. Importation of semi-synthetic antibiotics that are being produced in the country would be allowed only if the landed cost would be at least 20% lower than the prices of the Chemfield products.

To pursue the objective of increasing self-sufficiency in pharmaceutical production, the Philippine Government together with UNIDO and with UNDP funding, undertook the project entitled "Philippine Pharmaceutical Industry Development Study." The study identified the need to further evaluate the local production of penicillin G and 6-Amino-Penicillanic Acid (6-APA). Initial assessments tend to indicate that producing 6-APA from locally manufactured Penicillin G may not be commercially attractive. On the other hand, full integration (i.e. production of semi-synthetic penicillins all the way to formulation, packaging, and distribution of finished products) appears to offer more commercial possibilities. However, the substantial investment requirements for establishing an industrial scale penicillin fermentation plant coupled with existing underutilized production capacity for final dosage forms necessitates a deeper inquiry to ascertain the prospects of such a project. Hence, the government of the Philippines proposed a pre-feasibility study to be undertaken to investigate the financial and economic viability of various options of upstream/downstream integration of antibiotics production.

Such a pre-feasibility study will be useful to the Philippine Government in the formulation and implementation of policies to encourage local production of pharmaceutical raw materials. For interested investors, the pre-feasibility study will provide basic data and inputs for further analysis to come up with investment decisions. For financial institutions who may be tapped to provide loans to interested investors pursuing the project, the pre-feasibility study will provide an objective basis for loan evaluation.

II. OBJECTIVES

A pre-feasibility study is to be undertaken to investigate the commercial profitability and economic viability of the following three options:

(a) Production of Penicillin G, 6-APA, semi-synthetic penicillin, and formulation and packaging of dosage forms

(b) Importation of Penicillin G and production of 6-APA and downstream products specified in (a) above.

(c) Production of Penicillin G and 6-APA only.

This study is expected to provide the Government and potential investor(s) with a rational decision making basis to choose from three options in antibiotics production.

III SCOPE OF CONSULTANCY SERVICE

A pre-feasibility study will be undertaken in accordance with the UNIDO manual for feasibility studies on manufacturing. The outline of the study is as follows:

Chapter I Executive Summary

II Project Background and History

III Study on the Production of Penicillin G, 6-APA, Semi-Synthetic Penicillin, Formulation and Packaging of Dosage Forms

A. Market and Plant Capacity
B. Material and Imports
C. Location and Site
D. Project Engineering
E. Plant Organization and Overhead Costs
F. Manpower
G. Project Implementation
H. Financial and Economic Evaluation

IV Study on the Importation of Penicillin G and Production of 6-APA, and Packaging of Dosage Forms. (The task will be to undertake the same analyses as in III.A to III.H above)

V Study Production of Pen G and Producing 6-APA only. (The task will be to do the kind of analyses done in III.A to III.H above)

VI Conclusions and Recommendations

In undertaking the analyses specified in Chapters III, IV, and V, the following aspects must be covered.

1. MARKET STUDY

1.1 Determine the specific type of products to be produced in each stage of integrated production and assess the current level of domestic demand for each product.

1.2 Make projection for the likely growth in the local demand for each product for the coming 15 years. Indicate clearly all the assumptions made and sources of information used in forecasting the demand of each product.

1.3 Determine a competitive ex-factory price for each product, taking into account the existing international and domestic prices. Each product should determine two sets of prices, one for the external market and other for internal transfer pricing. Each price set-up should be justified by details of the price build-up.

1.4 Investigate Government incentives and protection measures which influence the pricing of the proposed products

1.5 Determine the most appropriate markets and distribution arrangement for each product sold to the external market

1.6 If the export potential exists: (a) assess potential export volume of selected products (b) identify the foreign markets (countries) and (c) elaborate the marketing strategy, procedures and policies to be pursued for export production of selected products to identified markets.

2. PLANT CAPACITY

On the basis of the demand projection, export possibilities and any other appropriate criteria which should be defined, determine the plant capacity in each stage of integrated operation, specifically:

2.1 a) Select optimum initial and full capacity for production of Penicillin G, 6-APA, semi-synthetic penicillin and formulated dosage forms (for Option I), or

b) Select optimum initial and full capacity for production of 6-APA, semi-synthetic ampicillin and formulated products (for Option II), or

c) Select optimum initial and full capacity for production of Penicillin G and 6-APA (for Option III)

2.2 State possibilities and provisions for future expansion and product diversification if deemed necessary for the above three options

2.3 Determine a feasible production programme for each product, in each option

3. RAW MATERIALS

3.1 Determine the annual requirement of the major raw materials to produce each product at each stage

3.2 Indicate the quantities, specifications and sources of alternative raw materials. Particular emphasis must be given to determining the availability of indigenous raw materials which may be used as substitute raw materials in the future

3.3 Investigate source of raw materials if additional raw materials other than those produced internationally would have to be procured to maintain an optimum level of production and explain if any particular nature of intermediates procurement such as import duties, etc.

3.4 Prepare a raw material procurement programme, taking into account the production of the finished products at each production chain as well as additional raw materials procured from outside of the integrated operation, if required.

4. LOCATION AND SITE

An appropriate location and site will be recommended for each option taking into account various determinants. Three different options for different site may be suggested, specifically:

4.1 List possible locations and describe them with respect to raw material and labor availability, proximity to market, infrastructure services, environmental considerations and any other additional relevant factors

4.2 Make recommendations for the most suitable site within the recommended location indicating it on an appropriate map. State availability and estimated cost of the optimum site as well as additional requirements for transportation, utilities and other services and facilities.

5. TECHNOLOGY AND PROJECT ENGINEERING

The investigation will cover impacts of integrated operation, compare with separate production of different down-stream products manufacturing specifically:

5.1 Outline the process flow and describe the selected technology for each level of production as well as for an integrated operation according to the specific requirements in each option. Justify the selection of comparing with other available forms of production for the same product, or alternative technologies.

5.2 List and specify the types and sizes of major machinery and equipment to be installed at each stage of production and justify the selection of the items

5.3 Describe the functions performed by each major unit at each stage of production

5.4 Specify auxiliary capital equipment and prepare a list of spare parts required for each production

5.5 Specify the necessary maintenance and repair facilities in an integrated manner for each option. This investigation may cover some cost saving from the common facilities used for different stages of production

5.6 Select the most feasible plant physical layout, stating the basis for the choice

5.7 Prepare equipment layout drawings to scale for each production facility and auxiliary shops. State impact of integration vis-a-vis, the equipment layout and auxiliary shops e.g. whether auxiliary facilities can be reduced due to integration of different production facilities

5.8 Prepare functional charts for process and material flow and draw energy balance diagramme for each production stage as well as in an integrated manner, if the integrated flow diagramme would differ substantively from the collection of the different down-stream production units

5.9 Specify as much as possible building and other civil engineering work requirements for the project broken down into sire preparation and development, building, storage facilities etc. State facilities commonly used for different down-stream production units

5.10 Provide brief site plan, if the site is finally determined for each option

5.11 Estimate the power, fuel and other utility requirements for each stage of production unit as well as for the integrated three options

5.12 Specify transportation facilities for raw materials and finished product and each stage of production

5.13 Indicate the type and volume of effluents and the necessary treatment facilities before disposal (if applicable)

6. PLANT ORGANIZATION AND MANPOWER REQUIREMENTS

6.1 Propose an organization structure for the option, showing all line and staff relationships. Specify duties and responsibilities of each function

6.2 Estimate total manpower requirements with breakdown of each unit of production as well as functional breakdown such as skilled, semi-skilled, un-skilled, technical managerial, etc.

6.3 Work-out training requirement for each production unit and specify minimum qualification required on the part of the trainees

6.4 Indicate how and where the training should take place as well as its duration

6.5 Identify technical assistance requirements of foreign experts; areas of specialization, duties, duration of assignments etc.

7. IMPLEMENTATION SCHEDULE

7.1 Work-out a detail implementation schedule showing major activities of the project such as detail engineering, tendering, contracting, delivery, construction, erection etc., with the aid of appropriate bar chart

7.2 Draw up manning programme for the project implementation period as well as for plant operation consistent with the implementation schedule

8. FINANCIAL EVALUATION

8.1 Provide all investment cost estimates broken down into foreign and local components on annual basis

8.2 Estimate the amount of working capital requirements, state specifically the criteria for its estimation

8.3 Estimate production and operating cost. Provide also sales revenue for each year

8.4 Prepare cash flow analysis for 15 years of project life

8.5 Calculate internal rate of return on total capital and on equity, and net present value of project at 18% hurdle rate

8.6 Prepare balance sheet, profit and loss account for 15 years

8.7 Prepare table for source and application of funds

8.8 Make a break-even analysis for production quality

8.9 Undertake sensitivity and risk analysis

8.10 Present suitable financial ratios

9. ECONOMIC ANALYSIS

9.1 Calculate the net present value using 15% discount rate as hurdle rate and the economic internal rate of return

9.2 Estimate the total employment that the option will create. Indicate cost of labor wages paid to laborers

9.3 Assess the impact of the project on the utilization of domestic resources

9.4 Analyze the stimulus effect of the project on other economic activities

9.5 Estimate foreign exchange saving/earnings

9.6 Estimate other economic or social benefits that will be generated by the project

9.7 Assess the effect of the project on the environment

9.8 Compute the domestic resource cost to determine or evaluate the cost of manufacturing locally as against importing the same products

Chapter VI must include a summary of conclusions and recommendations thereof. The report would select the most recommendable option out of three and state clearly the reasons.

IV. GENERAL TIME REQUIREMENT

The implementation schedule of this pre-feasibility study compilation is as follows:

Award of Contract	A
Fielding of Consultants	A + 0.5
Completion of market, raw material	
Completion of technological investigation.	A + 4.5

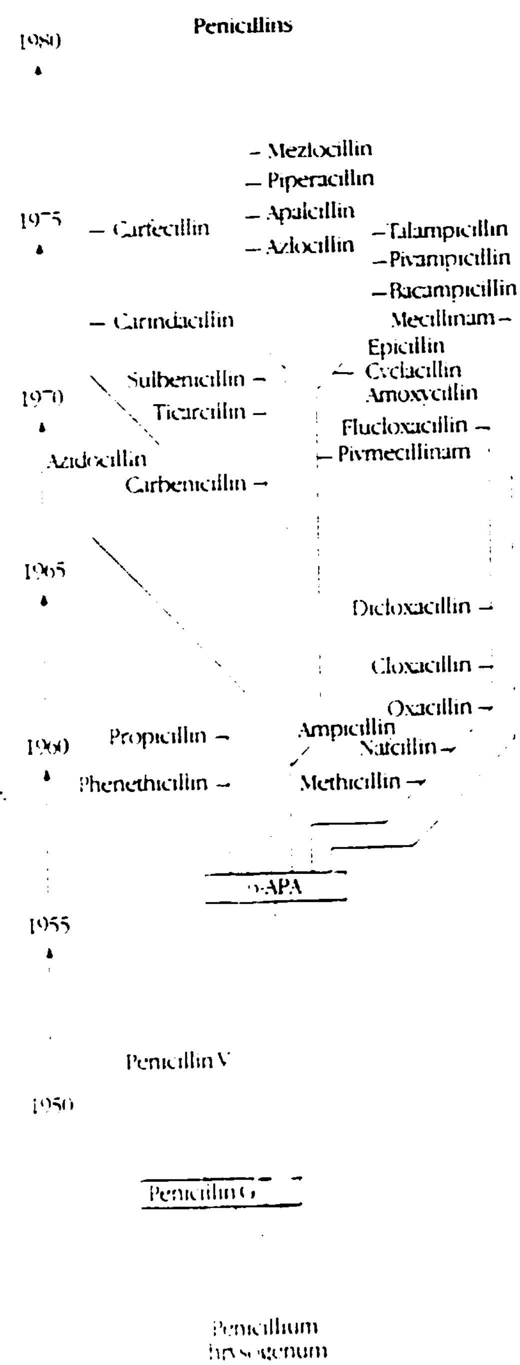
Compilation and submission of the draft final report	A + 5.5

UNIDO HQ will finalize the comment within 30 days after submission of the draft final report by the contractor. The final report will be submitted within 15 days after receipt of UNIDO comments.

V. THE REPORT

Twenty (20) copies of the final report compiled in English will be submitted by the contractor to UNIDO.

Figure 1
Development of the semisynthetic penicillins



The 40-year-old antibiotic era has been dominated by the beta-lactam antibiotics d[…] their excellent clinical efficacy and low pot[…] for adverse reactions.

Following the isolation in 1959 of the penic[…] nucleus – 6-amino-penicillanic acid (6-APA[…] large family of semisynthetic penicillins wa[…] evolved (Figure 1).

FIG I

APPENDIX 3-1

CLINICAL USAGE OF NATURAL AND SEMI-SYNTHETIC PENICILLINS

1. Natural Penicillins

1.1 **Penicillin G** has a strategic importance which far outweighs its clinical use, given that it is the basic raw material for the main semi-synthetic penicillins (see Fig. 1). For direct clinical use, it is known as benzylpenicillin.

1.2 **Benzylpenicillin** was the first of the penicillins, and it remains an important and useful antibiotic. It is the drug of choice for streptococcal, pneumococcal, gonococcal and meningococcal infections, and also for actinomycosis, anthrax, diphtheria, gas-gangrene, syphilis, tetanus and yaws. As it is rendered inactive by gastric acid and its absorption from the gut is low, it is normally given by injection.

1.3 **Procaine Penicillin** is a sparingly soluble salt of benzylpenicillin used in intramuscular depot preparations which provide therapeutic tissue concentrations for up to 24 hours. It is commonly used for the treatment of syphilis and gonorrhoea.

1.4 **Benethamine Penicillin** and **Benzathine Penicillin** are both benzylpenicillin salts with a very low solubility, which give a prolonged action after intramuscular injection. They are used for prophylaxis, combined with soluble and procaine penicillin.

1.5 **Phenoxymethylpenicillin** (or **Penicillin V**) has a similar antibacterial spectrum to benzylpenicillin, but it is less active. As it is gastric-acid stable, it is suitable for oral administration. It is normally used for respiratory tract infections in children and for streptococcal tonsillitis, as well as for continuing treatment after one or more injections of benzylpenicillin once clinical response has begun.

2. Semi-Synthetic Penicillins

2.1 **Ampicillin** is active against certain Gram-positive and Gram-negative organisms, but it is rendered inactive by penicillinases and a significant number of strains are now resistant to it. Ampicillin is normally given for the treatment of chronic bronchitis and middle-ear infections. It can be given orally before food, but less than half the dose is absorbed after oral administration and absorption is further decreased by the presence of food in the gut.

As a result, ampicillin is only shown in the Philippines National Drug Formulary in injectable form, and the Department of Health is no longer buying oral doses. It is likely that this attitude will spread to the private sector.

2.2 **Amoxycillin** is a derivative for ampicillin and is chemically very similar. It has a comparable antibacterial spectrum, but it is better absorbed when taken orally, and absorption is not affected by the presence of food in the stomach. The Department of Health has decided that amoxycillin is a more cost-effective drug than ampicillin for oral doses.

2.3 **Cloxacillin** is acid-stable and can therefore be given by mouth as well as by injection. Most staphylococci are now resistant to benzylpenicillin because they produce penicillinases. However, neither cloxacillin nor flucloxacillin are inactivated by these enzymes, and they are effective when used for the treatment of infections caused by penicillin-resistant staphylococci.

APPENDIX 3-2

WORLD MARKET FOR PHARMACEUTICALS

1. World Market for Pharmaceuticals

1.1 The development, manufacture and sale of pharmaceutical products is a major world industry, which is valued at approximately US$100 billion per year. It has also registered one of the fastest growth rates over the last decade, with an annual average of some 10%, although there have been some signs of a slowdown in this rate of growth in recent years.

1.2 About 75% to 80% of world sales in pharmaceuticals is concentrated in the industrialised countries, most notably in North America, Europe and Japan. Despite the fact that the developing countries account for 75% of world population, these account for a mere 20% of world sales.

1.3 The international pharmaceuticals industry is dominated by multinational companies which have a high profile and sell their own research-based products via marketing subsidiaries located world-wide. These products are protected by patent and, as a result, tend to command a high price. However, as the industry matures, an increasing number of important drugs have passed out of patent and have therefore entered the public domain. Generic drug manufacturers have taken these up, and there is now a commodity market in most essential drugs which is characterised by high-volume production and steadily falling prices.

1.4 Generic drugs are made to the same chemical formulae as branded drugs and are sold in the same market as the latter. Although they have made some inroads into the market in the industrialised countries, given the pressure generally to contain costs, their principal impact has been in the developing countries, where not only the requirement for basic drugs but also the financial constraints are more acute.

2. Relative Expenditure on Pharmaceuticals

2.1 Expenditure on pharmaceuticals is considerably lower in the developing world than in the industrialised nations. Estimates by the World Health Organisation suggest a typical per capita expenditure of $25 per year in the former, as compared with $100 to $150 per year in the latter. This is partly a factor of relative wealth, but is also because the pattern of drug usage differs quite markedly between the industrialised and developing countries of the world.

2.2 By way of example, the following table compares the market for drugs by main therapeutic class between the United Kingdom and the Philippines in 1990 :

Market for Drugs by Main Therapeutic Class : 1990

	United Kingdom	Philippines
Systemic Anti-Infectives	13.3%	25.4%
Respiratory System	13.1%	18.1%
Alimentary Tract/Metabolism	14.1%	17.1%
Central Nervous System	10.6%	7.4%
Cardiovascular System	12.8%	5.7%
Dermatologicals	3.9%	4.9%
Others	32.2%	21.4%
	100.0%	100.0%

Sources : Association of British Pharmaceuticals Industry
IMS
Trade Information

2.3 The demand for specific pharmaceuticals reflects the respective health profiles of the two populations. Systemic anti-infectives, of which penicillins play a major part, are the largest single category of drugs used in the Philippines, whereas they account for only 13% of the United Kingdom market. If drugs for the respiratory system and the alimentary tract are included with the anti-infectives, these products account for over 60% of total drugs usage in the Philippines, as against a figure of 40% in the United Kingdom. Many of the drugs in these categories have passed out of patent, and generic versions are available.

APPENDIX 3-3

WORLD MARKET FOR ANTIBIOTICS

1. World Usage of Antibiotics

1.1 Although the industrialised nations dominate the world market for antibiotics, these drugs are relatively more important throughout the developing world :

World Usage of Antibiotics : 1990

	Sales $ million	%	Annual Growth Rate 1985-90
North America	3,150	12%	4%
Europe	8,700	33%	4%
Japan	4,950	18%	7%
Rest of the World	9,800	37%	8%
Overall	26,600	100%	6%

Source : Industry Estimates

1.2 It is therefore evident that the developing nations use a much higher proportion of world production of antibiotics than they do of most other pharmaceuticals. Moreover, this proportion is likely to increase in the foreseeable future, as the growth rate of consumption has been identified as being twice as high as that in North America and Europe.

1.3 The high demand for antibiotics in developing nations is a logical response to the health profile of the population. For example, in an article on the subject of antibiotics in the Philippines, Dr Cecilia Isaac states that :

> "Infections are the number one disease problem in this country. Of the ten leading causes of morbidity, seven are infectious diseases. Of the ten leading causes of mortality, four are infectious diseases. Pneumonia and TB are still our leading causes of death."

1.4 This health profile is exacerbated by social conditions. Again, according to Dr Isaac :

> "In the Philippines, control of infection continues to elude all the wonder drugs because of the underlying problems of malnutrition, lack of sanitation and the state of poverty of our people. Infection is easily spread. A vicious cycle develops with repeated bouts of relapsing illnesses giving rise to resistant strains of organisms, new pathogens and incomplete clinical response."

1.5 Within the category of antibiotics, penicillins comprise the largest group of drugs used throughout the world :

Relative Importance of Antibiotics : 1990

	World	North America	Europe	Japan	Rest of World
Penicillins	33%	15%	20%	17%	34%
Cephalosporins	29%	40%	45%	60%	20%
Tetracyclines	10%	8%	7%	5%	17%
Erythromycins	8%	9%	7%	3%	10%
Aminoglycosides	6%	6%	6%	9%	4%
Others	4%	22%	15%	6%	15%
	100%	100%	100%	100%	100%

Source : Industry Estimates

2. Current Trend in Demand for Antibiotics

2.1 It is apparent from the foregoing that the traditional penicillins and the cephalosporins, which are created by similar fermentation techniques, account for over 60% of overall world demand for antibiotics, and for 54% of that in the non-industrialised countries. This proportion is likely to increase in the latter in particular :

Current Growth Rates of Antibiotics Usage

	World Growth	North America	Europe	Japan	Rest of World
Penicillins	6%	1%	4%	4%	14%
Cephalosporins	9%	7%	10%	11%	8%
Tetracyclines	4%	1%	1%	3%	6%
Erythromycins	4%	1%	4%	2%	6%
Aminoglycosides	3%	2%	2%	5%	5%
Other	4%	4%	1%	11%	8%

Source : Industry Estimates

2.2 Because penicillins enjoy the highest rates of growth in demand in the developing countries, the establishment of a penicillin fermentation plant would serve not only the largest segment of the market, but also that which shows the greatest potential for further development.

APPENDIX 3-4

MARKET FOR ANTIBIOTICS IN THE PHILIPPINES

1. Relative Usage of Antibiotics

1.1 Based on demand by drugstores and hospitals, natural and semi-synthetic penicillins together dominate the Philippines market for antibiotics, accounting for more than a third of the volume and just under half the value in 1990. No other class of drug approaches the penicillins in terms of percentage share of the market :

	% by Volume	% by Value
Penicillins	36.4%	44.4%
Cephalosporins	2.2%	9.8%
Tetracyclines	8.8%	6.3%
Erythromycins	4.9%	6.2%
Aminoglycosides	27.3%	11.1%
Rifamycins	4.2%	10.0%
Others	16.2%	12.2%
	100.0%	100.0%

Source : IMS Pacific

1.2 It must be emphasised that this demonstrates relative demand in the private medical sector alone. Unfortunately, it is not possible to calculate public sector demand on the same basis, as the figures are not comparable, but penicillins also comprise the bulk of government purchases of antibiotics. If these latter figures, together with the demand for animal feed products, are consolidated with private sector demand, the proportion of penicillins relative to the total would exceed 50% by volume.

2. Relative Importance of Penicillins

2.1 Looking at the usage of penicillins more closely, these can be ranked in order of size so as to give a clearer indication of the relative importance of each individual product in the Philippines. It may be noted that natural penicillins have been grouped in with the semi-synthetic penicillins, as they are derived from the same feedstock :

Rank	Active Ingredient	% by Value
1	Ampicillin	32.2%
2	Amoxycillin	30.2%
3	Natural Penicillins (V and G)	14.4%
4	Cloxacillin	8.4%
5	Becampicillin	4.5%
6	Oxacillin	2.5%
7	Nafcillin	1.9%
8	Epicillin	1.2%
9	Others	4.7%
		100.0%

Source : IMS Pacific

2.2 None of the "other" semi-synthetics amounted to more than 1% of total demand. However, for the sake of completeness, these may be ranked in order of importance as follows :

Pivampicillin
Pivmecillinam
Sulbenicillin
Piperacillin
Sulbactam
Cyclacillin
Mezlocillin
Metampicillin
Ticarcillin
Mecillinam
Carbenicillin

2.3 A clear pattern of demand thus emerges, with Ampicillin and Amoxycillin dominating the demand figures recorded in respect of drugstores and hospitals, followed by the natural penicillins and cloxacillin. All together, these products accounted for just over 85% of the total.

2.4 With regard to the remaining balance of 15%, no other semi-synthetic accounted for more than 5% of demand. At such low levels, these drugs are used for specialist purposes only, and the demand pattern is likely to be irregular.

APPENDIX 3-5

SOURCES OF MARKET DATA : SUPPLY STATISTICS

1. Domestic Production

1.1 At the present time, neither Pen-G nor Pen-V is being manufactured in the Philippines. However, bulk supplies of ampicillin, amoxycillin and cloxacillin are being produced for the domestic market by Chemfields, a pharmaceutical factory which is jointly owned by the Government of the Philippines and United Laboratories. The latter is the largest Filipino-owned manufacturer of pharmaceuticals in the country, and Chemfields is the main source of supply of bulk chemicals to domestic formulators and compounders.

1.2 In view of the fact that Chemfields is currently responsible for meeting the greater part of domestic demand for semi-synthetic penicillins, it was initially hoped that up-to-date market data would be available from this source. Unfortunately, whilst every cooperation was received in general terms, the management of Chemfields was reluctant to divulge what was regarded as confidential information on production and marketing to the study team, despite representations at the highest level.

1.3 It is understood that Chemfields has filed a comprehensive document detailing production figures for 1988, 1989 and part of 1990 with the Board of Investment as part of its application for an expansion project. However, given that only employees of the Board of Investment are allowed access to this document, it has been necessary to arrive at "informed estimates" by using a number of other sources :

- A previous report commissioned by UNIDO enjoyed the full cooperation of Chemfields, and it was possible to derive accurate production figures for 1985, 1986 and 1987 from this document.

- As part of its on-going relationship with the Bureau of Food and Drugs, Chemfields submits a monthly return to the former. It is unfortunately the case that these records are incomplete, and the study team was only able to locate nine returns dated between February 1990 and January 1991. These form the main basis of our estimates.

- In order to cross-check the production estimates, we calculated the imports of 6-APA by Chemfields in 1988, 1989 and 1990.

1.4 The historic data from the previous UNIDO report shows that Chemfields built up its production capacity from an installed level of 50 tonnes in 1982 to just over 75 tonnes in 1987 :

Tonnes	1985	1986	1987
Ampicillin Trihydrate	39.90	30.75	51.60
Amoxycillin Trihydrate	16.30	15.25	22.50
Anhydrous Ampicillin	1.15	1.56	1.35
Sodium Cloxacillin	-	0.50	-
Total	57.35	48.06	75.45

1.5 The returns made to the Bureau of Food and Drugs show an erratic level of production, and no trend is clearly discernable. However, the total for the nine months in question would seem to indicate an annual production figure of about 100 tonnes :

kgs	Ampicillin Trihydrate	Amoxycillin Trihydrate	Anhydrous Ampicillin	Sodium Cloxacillin	Total
Feb'90	-	4138.95	731.75	1221.95	6092.65
Mar'90	4082.45	809.95	-	1039.35	5931.75
May'90	1309.00	5061.05	-	1914.90	8284.95
Jul'90	3186.55	6528.45	-	-	9715.00
Aug'90	3555.75	-	-	419.70	3975.45
Sep'90	3147.15	9286.40	-	1265.00	13698.55
Oct'90	13512.70	-	-	48.45	13561.15
Dec'90	2214.35	1007.15	-	2898.90	6120.40
Jan'91	1687.70	5910.40	104.05	616.80	8318.95
Total	32695.65	32742.35	835.80	9425.05	75698.85
Monthly Average	3632.85	3638.04	92.87	1047.23	8410.98
Annualised Figure	43594.20	43656.48	1114.44	12566.76	100931.76

1.6 Sales figures for the same period show a slightly different pattern, and the average totals are less than production. In particular, amoxycillin sales are considerably lower than the production volumes :

kgs	Ampicillin Trihydrate	Amoxycillin Trihydrate	Anhydrous Ampicillin	Sodium Cloxacillin	Total
Feb'90	1850	2105	-	1100	5055
Mar'90	2815	2582	-	450	5847
May'90	5190	3195	-	1000	9385
Jul'90	4470	2475	-	750	7695
Aug'90	4455	4390	-	450	9295
Sep'90	5490	3575	-	400	9465
Oct'90	5550	1670	-	725	7945
Dec'90	2250	1045	-	790	4085
Jan'91	3245	2745	-	600	6590
Total	35315	23782	-	6265	65362
Monthly Average	3924	2642	-	696	7262
Annualised Figure	47087	31709	-	8353	87149

1.7 Recorded imports of 6-APA, the basic feedstock, would also seem to suggest that the production figures detailed in the BFAD returns are on the high side :

	1988	1989	1990
Imports of 6-APA (kgs)	38,410	31,940	51,780
Average Price per Kg	$64.97	$58.45	$49.81
Calculated Output of Fine Chemical (kgs)	60,000	50,000	80,000

Note : The output of fine chemical has been calculated by reference to the chemical process used to estimate the approximate yield of finished product from the 6-APA feedstock.

1.8 Taking all the data obtained into consideration, it is estimated that Chemfields produced and sold the following tonnages of bulk pharmaceuticals in 1990 :

	Production	Sales
Ampicillin	46 tonnes	47 tonnes
Amoxycillin	44 tonnes	32 tonnes
Cloxacillin	12 tonnes	8 tonnes
Total	102 tonnes	87 tonnes

2. Customs Information

2.1 General details of all imports are readily available from Customs in the form of Foreign Trade Statistics. However, although these were of some use when adopting a "broad brush" approach, they were not sufficiently specific for the purposes of this study :

Imports of Penicillin and Derivatives : 1988-1990

	Bulk Chemicals	Prepared Pharmaceuticals
1988	82,288 kgs	1,774,085 gms
1989	97,016 kgs	2,578,645 gms
1990	106,610 kgs	1,039,743 gms

Source : Department of Customs

2.2 Unfortunately, we were unable to gain access to the original documentation in order to elicit the detailed information required. The National Statistics Office has recently changed its offices, and no sorting or individual research of the records for 1990 can be permitted until such time as these have been refiled in the correct sequence.

2.3 Detailed records for the five months from January to May 1991 were examined and collated, but the results were too limited to prove useful.

3. Business Statistics Monitor

3.1 The Business Statistics Monitor (BSM) is a private company which sells information on all imports into the Philippines. Its data is based on the original documentation received by Customs, and should therefore be identical in every way, but due allowance should also be made for human error at each successive stage of data processing. Such inaccuracies are nevertheless unlikely to have a material impact on any analysis, consequently after analysis the base data from this source has been used as a substitute for the original customs records.

3.2 A time series for four years, from 1987 through to 1990 inclusive, was built up by analysing each pharmaceutical importation record (both sea and air), identifying the products in which we were interested, and then calculating the amount of active ingredient in each shipment. 13% of the BSM records were initially unusable owing to errors identified but, after detailed analysis and checking, the overall total was reduced to less than 4%. This was regarded as an acceptable margin for which due allowance could be made in the calculations.

Imports of Pharmaceuticals : 1987-1990

kgs	1987	1988	1989	1990
Pen-G	17,718	11,194	17,254	20,914
Pen-V	26,959	19,523	17,920	20,653
Ampicillin	1,600	435	3,835	1,663
Amoxycillin	1,800	6,263	8,287	20,234
Cloxacillin	4,900	11	8	18

Source : Business Statistics Monitor

3.3 In any country, imports vary widely from year to year, and it would be misleading to subject these figures to any statistical analysis. However, certain broad trends agree with our knowledge of the market :

- Although showing slow growth over time, both **Pen-G** and **Pen-V** are basic, well-established pharmaceuticals.

- **Ampicillin** is imported mainly in dosage form by the established manufacturers to supplement the bulk pharmaceutical produced by Chemfields and purchased locally.

- Similarly, **amoxycillin** is brought in by the main manufacturers in dosage form, and sometimes in bulk, in order to supplement local purchases. However, the main importers of bulk amoxycillin which are responsible for the tenfold rise in imports over the last four years, are those firms which have been awarded government contracts for supplying this product to the Department of Health. There is no indication of these firms buying their requirements from Chemfields, and it would appear that they prefer to source on the world market.

- **Cloxacillin** imports have declined to negligible proportion since Chemfields commenced the local manufacture of this product.

3.4 Looking at the Penicillin imports in rather more detail, it is apparent that, on average, about 35% of the Pen-G is feed-grade, destined for formulating into animal feed :

Imports of Penicillins : 1987-1990

kgs	1987	1988	1989	1990
Pen-G Potassium	8,176	2,031	6,891	6,511
Pen-G Sodium	2,990	3,057	3,000	801
Pen-G Benzathine	157	31	62	-
Pen-G Procaine (sterile)	1,567	1,639	2,347	2,025
Pen-G Procaine (feedgrade)	4,828	4,436	4,954	11,577
Total	17,718	11,194	17,254	20,914
Pen-V Potassium	25,956	19,241	17,520	20,559
Pen-V Acid	1,003	282	400	94
Total	26,959	19,523	17,920	20,653

Source : Business Statistics Monitor

3.5 Although imports of Pen-G feedgrade remained fairly constant in tonnage terms for the first three years under review, they more than doubled in volume in 1990. However, we do not believe that this is indicative of a trend, and merely represents a "bunching" of imports in that year. This view is supported by the fact that local importers were not aware of any significant change in market demand.

4. Sources of Error

4.1 Pharmaceuticals are a technical subject, and human errors in the recording of data could be identified in all the information sources referred to. These included :

- **Imprecise Descriptions** : For example, "penicillin" in isolation cannot be identified precisely enough for our purposes, whilst an analysis of volume cannot be based on "boxes" or "cartons".

- **Inaccurate Descriptions** : Fortunately, these were normally minor and could be deduced correctly.

- **Clerical Error** : Commonsense could sometimes eliminate this type of error, but it was inevitable that some should slip through.

- **Shipment Weight** : In a significant number of cases, gross weight and net weight were not specified, or were omitted altogether.

- **Variety of Units** : The history and multinational origins of the pharmaceuticals industry has led to a multiplicity of terms in use, and to some confusion. These are only now being rationalised world-wide.

4.2 It may be noted that the applications submitted to the BFD could be used to extend the scope of existing knowledge regarding the pharmaceutical manufacturing sector. At the present time, all applications are expressed in a variety of units and a mixture of generic and brand names. If these were to be changed and rationalised so that applicants were required to express the quantities of active ingredient in kgs, it would be a relatively simple task to keep an on-going record of important fine chemicals.

4.3 This would not only facilitate planning for the industry, but would also reduce the present reliance on customs information, which is both less up-to-date and less precise.

5. Unrecorded Imports

5.1 It is widely accepted that a proportion of the drugs which are in use in the Philippines are brought in illegally, either as a result of being wrongly classified or through the normal customs procedures being short-circuited. This can occur as a result of human error but, more often than not, an element of corruption is involved.

5.2 It is impossible to quantify the extent of illegal importation with any accuracy, and estimates obtained in the course of discussions varied widely. In general, however, it was agreed that the smaller companies run by individual entrepreneurs, which have no regular market and hence no established distribution arrangements, were the most likely to become involved in this trade. In addition, it is clear that the higher the value of the drug, the greater the incentive to bring this in illegally.

5.3 On the basis of the foregoing, due provision should also be made for illegal or unrecorded imports when assessing the overall market for the products in question. In general, it is our view that about 5% of the drugs which are most commonly used are not recorded in the official import statistics. The main exception to this is amoxycillin, for which large tenders are put out by the Department of Health, with "one-off" contracts being awarded to a wide variety of both large and small suppliers. Given that the latter in particular may not have established distribution networks, the likelihood of the product being brought in illegally is significantly increased. We have therefore provided for up to 15% of amoxycillin demand to be met from unrecorded sources.

APPENDIX 3-6

SOURCES OF MARKET DATA : DEMAND STATISTICS

1. Private Sector Demand

1.1 IMS Pacific is a private research agency which specialises in measuring the demand for drugs via pharmacies. It was originally established in the United States in 1954, and is now a subsidiary of Dun & Bradstreet. IMS operates as part of a world-wide network of sixty branches, all of which collect information on a comparable basis. The multinational companies comprise its principal client base.

1.2 IMS is the only organisation of its kind, and the statistics produced are believed to be the best available with regard to private sector demand. We examined their sampling techniques in detail and can confirm that these appear to be soundly based, although there are some major omissions: for example, the retail pharmacy chain which accounts for an estimated 40% of the Philippines market, Mercury Drug, does not participate in the IMS survey, whilst the private hospitals are over-represented at the expense of the public hospitals (which make direct purchases). However, IMS recognises these shortcomings, and claims to make due allowance for them in its overall estimates :

Private Sector Demand for Semi-Synthetic Penicillins : 1990

kgs	Pharmacies	Hospitals	Total
Ampicillin			
Branded	20,304	2,290	22,594
Unbranded	1,020	252	1,272
Total	21,324	2,542	23,866
Amoxycillin			
Branded	14,542	2,148	16,690
Unbranded	1,286	180	1,466
Total	15,828	2,328	18,156

Source : IMS Pacific

1.3 It should be emphasised that these figures only take into account those drugs which follow the traditional distribution routes to the private sector. They do not include direct imports by wholesalers/retailers, direct purchases from manufacturers or government purchases in any form.

1.4 United Laboratories are the biggest manufacturers of pharmaceuticals in the Philippines, with an estimated 20% share of the overall market, and have compiled their own estimates of market demand for management and planning purposes. These latter have a wider scope than the IMS figures, but still omit significant sectors of the industry, including direct purchases by government :

Estimates of Market Size : 1990

Penicillin-G	50,000 kgs
Penicillin-V	35,000 kgs
Ampicillin	60,000 kgs
Amoxycillin	49,000 kgs

Source : United Laboratories

1.5 Unfortunately, the estimates of market size obtained from these two sou es are subject to certain inconsistencies : in particular, .MS estimates the demand for ampicillin and amoxycillin to be no more than about 40% of the figure suggested by United Laboratories. As a result, neither set of figures can be used as the basis for estimating the size of the market, although they do provide some useful pointers.

1.6 However, where these independent analyses do come into their own is in establishing a reliable time series, given that both companies have been studying the market for a number of years, using comparable sampling methods. More reliance can thus be placed on the measurement of market growth than on the figures in absolute value terms.

2. Public Sector Demand

2.1 The Government of the Philippines is a major user of pharmaceuticals, and is by far the largest single purchaser in the country. The Department of Health (DOH)is the largest single buyer of drugs within government, but many other departments have an interest in, and hence a budget for these products :

Government Purchasers of Drugs

Department of Health : Regional Health Units
Specialist Hospitals
Philippines General Hospitals
Action Programmes
Special Programmes/Projects
(externally funded)

Other Departments	:	Congress Central Procurement Armed Forces Education Quasi-Government Organisations

2.2 Each of these groupings, or units within each group, have their own budgets and individual authority to purchase their drug requirements. There is no central co-ordination of the purchasing function, other than the financial controls imposed by the budget office. The complexity of the present situation is likely to further increase in the future as a result of the policy of decentralisation, and the creation of yet more buying points with individual responsibility.

2.3 The total DOH budget for pharmaceuticals in 1990 amounted to just under one billion Pesos (approximately equivalent to $37 million), and the budgetary controls allocated a proportion of this total to each of the spending areas. Unfortunately, the records available do not clearly identify whether these allocations were all taken up and, if so, whether they were used for the purchase of drugs or other medical supplies. Nor are there any comprehensive records as to the types and quantities of drugs purchased, given that the departmental policy gives the regional and sectoral administrators considerable autonomy.

2.4 We therefore concentrated on two major areas of consumption in order to get a representative view of drug types and quantities : namely, hospital usage and the Regional Health Unit (RHU) programme.

2.5 A survey of the monthly consumption of relevant drugs was carried out in a small sample of hospitals in Luzon, and the results of the sample survey were then grossed up to a national figure on the basis of the official statistics of hospital beds in the country :

Hospital Demand for Selected Drugs : 1991

Penicillin-G	357 kgs
Ampicillin	1,405 kgs
Amoxycillin	9,680 kgs
Cloxacillin	1,665 kgs

Source : Usage in 500 hospital beds over a 3-month period

2.6 Given that the survey was restricted to those drugs in the Philippine National Drug Formulary in order to get consistent coverage, and more dosage forms are in use than are listed in the latter, it is undoubtedly the case that both the Pen-G and ampicillin figures are under-stated. In general terms, however, these figures appear to be more realistic that the equivalent sample compiled by IMS (paragraph 1.2 refers).

2.7 The purchase pattern of the network of RHUs shows a much simpler pattern of basic remedies and less sophisticated drug usage relative to that in the public sector. We examined the RHU tender invitations over a period of four years, from 1987 to 1990 inclusive, and analysed the weight of bulk chemicals needed to fulfil those requirements :

RHU Requirements of Selected Drugs : 1987 - 1990

kgs	1987	1988	1989	1990
Amoxycillin				
10ml drops	827.7	4049.7	380.0	906.6
Syrup	5346.0	9372.1	11041.0	-
Suspension 125	-	-	-	583.5
Suspension 250	-	-	-	2954.8
Capsule 250	2670.0	6400.4	6473.3	2182.9
Capsule 500	2599.8	3491.1	4979.9	4929.5
	11443.5	23313.3	22874.2	11557.3
Penicillin-V				
Drops	-	-	-	4.0
Suspension 125	-	-	-	81.5
Suspension 250	-	-	-	379.3
Capsule 250	-	-	-	114.7
Capsule 500	-	-	146.6	1473.2
	-	-	146.6	2052.7

Source : Department of Health

2.8 In order to check whether the requirements of the RHU Programme were subsequently purchased, we compared the requirements for 1989 against the actual awards made. In general, the amounts in question tallied, but the purchase of amoxycillin appeared to be almost double the required quantity (40 tonnes as against 22.9 tonnes). We were unable to resolve this discrepancy satisfactorily but, as the figures for the following year were significantly lower, it is reasonable to assume that the 1989 purchase was made for a special purpose, with any surplus balances being carried over to satisfy part of the 1990 requirement.

2.9 By any standards, the RHU consumption of amoxycillin is substantial, and it is a significant factor in the overall market. The other drugs under consideration play a much smaller role, primarily because they have to be administered by trained personnel.

2.10 Other examples of government buying were investigated, including that of the military which has a substantial budget for pharmaceuticals, but it was not possible to obtain details of the types and quantities of drugs involved. For example, the general budget for the Armed Forces in 1990 included a sum of P 10 million for drugs. In addition, the individual branches of the Services each had their own allowances, the main ones being :

Headquarters	:	P 10 million
Army	:	P 40 million
Air Force	:	P 10 million
Navy	:	P 12 million
Constabulary	:	P 6 million
Medical Centre	:	P 16 million

2.11 It also transpired that minor government purchases were often not large enough to justify separate importation of bulk chemicals by the successful contractor, and would thus pass through normal distribution channels. Depending upon the size of the order, these requirements would be supplied by wholesalers or retailers from their normal stocks.

APPENDIX 3-7

HISTORIC GROWTH RATES IN THE MARKET FOR DRUGS IN THE PHILIPPINES

1. Market Growth : 1980 - 1990

1.1 Although historic growth rates should not be used to interpolate growth over an extended period of time, they are of relevance in setting parameters for the future development of the market.

1.2 Both IMS and United Laboratories have measured the market for drugs in the Philippines over at least the last ten years. Their figures only account for part of the total market for the products in question but, given that the survey methods used have been consistent, the growth rates indicated can be taken as a reliable measure overall.

1.3 In simple value terms, the total drug market has increased nearly five-fold over the last decade to a total of approximately 12 billion Pesos (equivalent to US$ 450 million). These figures are exaggerated by inflation and real growth has been much less dramatic, but it has nevertheless remained significant :

Ten-Year Growth Rates : 1980 - 1990

	Overall Growth Current Prices	Overall Growth Constant Prices	Annual Growth Rate
Total Market	+ 446%	+ 61%	+ 4.75%
Anti-Infectives	+ 541%	+ 90%	+ 6.70%
Broad Spectrum Penicillins	+ 549%	+ 92%	+ 6.75%
Ampicillin	+ 362%	+ 37%	+ 3.25%
Amoxycillin	+ 1765%	+ 452%	+ 16.50%

Source : IMS Pacific

1.4 The IMS figures at constant prices show that, in real terms, the market for pharmaceutical products has grown by 4.75% per year for the last ten years. However, within that total market, demand for anti-infectives and broad spectrum penicillins has been growing at much faster rates of up to 6.75% per year. Although ampicillin is included within the latter category, its growth rate has been relatively slow at 3.25%. In contrast, demand for amoxycillin has exploded, increasing at an annual average of 16.5%. Comparative figures are not available for natural penicillins, but pharmacists are agreed that long term growth has again been consistently above average in real terms.

1.5 Given that the increase in population during this period is put at 2.36% p.a., it is evident that the total market for pharmaceuticals has been expanding at approximately twice the rate of population growth.

2. **Market Growth : 1986 - 1990**

2.1 In contrast to the foregoing, the overall drug market has out-paced the growth in demand for both anti-infectives and broad spectrum penicillins over the last four years. This has been largely caused by the decline in the popularity of ampicillin.

Four-Year Growth Rates : 1986 - 1990

	Overall Growth Constant Prices	Annual Growth Rate
Total Market	+ 24%	+ 5.5%
Anti-Infectives	+ 23%	+ 5.3%
Broad Spectrum Penicillins	+ 18%	+ 4.2%
Ampicillin	- 3%	- 0.7%
Amoxycillin	+ 74%	+ 15.0%

Source : IMS Pacific

2.2 The evidence of a relative decline in ampicillin and a dramatic rise in amoxycillin is supported by independent research carried out by United Laboratories :

Growth Rates of Selected Drugs : 1985 - 1990

	Overall Growth	Annual Growth	Growth in 1989
Ampicillin	+ 8%	+ 1.5%	- 3.6%
Amoxycillin	+ 103%	+ 15.2%	+ 24.4%
Pen-G	+ 61%	+ 10.0%	+ 14.1%
Pen-V	+ 25%	+ 4.6%	- 1.1%

Source : United Laboratories

2.3 The fact that the market for amoxycillin increased by a record amount between 1989 and 1990 may be partially attributed to government policy, in that oral ampicillins were dropped from the National Drug Formulary. The advice is being slowly heeded by the private sector, and amoxycillin and other semi-synthetics will gradually be substituted for ampicillin as medium and longer term prescription habits change in their favour.

2.4 The consistently high rate of growth recorded in drug sales is not a phenomenon which is peculiar to the Philippines, but has been repeated in most countries. When the economy is growing rapidly, drug sales follow the same trend. Moreover, whilst drug sales are not recession-proof, they are highly resistant to downturns in the economy and will merely show a slower rate of growth when the economy is in decline.

2.5 The one exception to this was a short period in 1983/84 when, for two years in succession, sales declined in real terms. This was partly caused (and then exacerbated) by massive price rises affecting drugs and other essentials at that time.

APPENDIX 3-8

FUTURE GROWTH IN DEMAND

1. Population Growth

1.1 The single most important factor affecting the market for drugs is the population of the country : as the population rises, so too will the demand for drugs.

1.2 Provisional figures have been released for the 1990 census, which show that the population of the Philippines now exceeds 60 million persons :

Population of the Philippines : 1990

Region	Population millions	As % of Total
National Capital Region	7.929	13.1%
Cordillera Autonomous Region	1.146	1.9%
1. Ilocos	3.551	5.9%
2. Cagayan Valley	2.341	3.9%
3. Central Luzon	6.199	10.2%
4. Southern Tagalog	8.266	13.6%
5. Bicol Region	3.910	6.4%
6. Western Visayas	5.393	8.9%
7. Central Visayas	4.593	7.6%
8. Eastern Visayas	3.055	5.0%
9. Western Mindanao	3.159	5.2%
10. Northern Mindanao	3.510	5.8%
11. Southern Mindanao	4.457	7.3%
12. Central Mindanao	3.171	5.2%
Total	60.680	100.0%

Source : Census

1.3 The annual population growth rate has averaged 2.36% over the last decade, but this is gradually slowing down as the demographic pattern changes and gradual urbanisation in particular results in smaller families. New forecasts have yet to be published for the foreseeable future but, in discussion with several demographers at the National Statistics Office, a consensus was reached which suggested the following growth rates over the next 15 years :

1991 - 1995	:	2.25% per year
1996 - 2000	:	2.10% per year
2001 - 2005	:	1.90% per year

1.4 These figures are somewhat higher than the World Bank forecast of 1.9% per year from 1987 through to the year 2001. However, given the results of the 1990 census, we believe that the assessment of the national experts is probably more realistic.

2. Health Profile

2.1 In relation to many other developing countries, the level of health care provided in the Philippines is good. It is evident that the health of the population is improving gradually, but reductions in morbidity and mortality rates take a long time to show up in the statistics.

2.2 Despite a drift to the cities, 60% of the population is essentially rural. According to figures compiled in 1988, 49.5% of the population of the country is also classified as being below the poverty line, officially defined as an income which does not exceed 2,709 pesos per month for a family of six (roughly equivalent to $100 per month). Only 10% of the population can be classified as upper or middle class, whilst a total of 80% describe themselves as being either poor or borderline.

2.3 One consequence of this is that communicable diseases dominate the morbidity tables, as the underlying problems of overcrowding, poor hygiene conditions and malnutrition all serve to increase the spread of infection. Antibiotics are particularly important in this context, and government medical services believe that they are likely to continue to represent at least 20% of drug expenditure in the foreseeable future.

3. Income

3.1 The demand for drugs is highly elastic : that is, given an increase in income received, the additional spending on drugs is likely to exceed that increase in percentage terms. This is reflected in the fact that, as GNP has increased, so too has expenditure on family health risen from 1.7% of income in 1965 to 2.1% at the present time. We would anticipate a similar slow rate of growth in this proportion over the next fifteen years.

4. Government Policy

4.1 Contrary to expectation, the proportion of government expenditure allocated to health has dropped from 3.9% to 2.6% over the last fifteen years. This is because 45% of government expenditure is now earmarked for debt servicing, as compared with 5% in 1976, consequently each sector of government receives a smaller share of the overall budget.

4.2 However, if debt servicing is excluded, it is clear that the Department of Health has fared better than others in terms of government funding. For example, the budget for health increased by 16% in real terms between 1979 and 1989, whereas that for agriculture and communications declined by 32% and 36% respectively. The only major area of government spending to exceed health in terms of real budget growth was education, where the increase was 60%.

4.3 Although political aims can change quickly, the provision of health care in general, and the control of communicable diseases in particular, are likely to remain priorities for the current administration in the foreseeable future.

5. Prescription Patterns

5.1 The elimination of all oral forms of ampicillin from the National Drug Formulary, published in 1989, has already had a significant impact on the overall demand for ampicillin. This decline will continue, and accelerate, as the drug education programme extends to more doctors in the private sector and they, in turn, influence their patients through the prescriptions given.

5.2 Conversely, the market for amoxycillin is expected to increase, given that it is a suitable drug for oral treatments and appears in all forms on the National Drug Formulary. However, the dramatic increase in demand recorded in the recent past may be at least partially attributed to the switch in government policy noted above. Although demand for amoxycillin will continue to grow throughout the time-scale of the project, it is thus unlikely that past growth rates will be sustained.

5.3 Cloxacillin is a specialist drug, as well as being considerably more expensive. Its use is nevertheless likely to increase as it becomes better known, and its penicillinase-resistant qualities become more important.

5.4 Pen-G for human use is still a preferred general purpose antibacterium and, despite the erosion of its market base caused by the introduction of newer drugs, it should show steady growth. The market for feedgrade quality is likely to reflect limited growth only, given that the emphasis in agriculture is turning more to fish farming and crops.

5.5 Although Pen-V is still widely used, it is both more limited in its application than Pen-G and even more susceptible to replacement by other drugs. There have been signs of slight decline in the last two years, and this decline will become more pronounced over the next decade.

APPENDIX 3-9

EVALUATION OF DATA SOURCES

1. Domestic Production and Sales

1.1 The monthly returns by Chemfields to BFAD are detailed and, presumably accurate but are also incomplete. This could be either because they were not submitted by Chemfields, or have been mislaid by BFAD.

1.2 The production of semi-synthetics was also calculated by reference to import statistics showing the amount of 6-APA brought in by Chemfields.

1.3 Details of additional capital investment and data on annual production were obtained from the applications and back-up material on public record at the Board of Investment.

1.4 A previous report for UNIDO on the pharmaceutical industry appeared to have the full cooperation of Chemfields, and contained information which allowed us to extend the time series for Chemfields production.

2. Imports

2.1 Published Customs statistics are too general for the purposes of a detailed study, and we needed access to the original documentation. This could not be made available to us as the archives had recently been re-located.

2.2 Business Statistics Monitor uses the same customs data on a contemporaneous basis to record all sea and air imports. The only errors found in these records were carried over from the original documentation, and included imprecise descriptions, quantities, etc. We therefore have a high degree of confidence in this data source.

2.3 Both the Central Bank and BFAD have to authorise any imports of antibiotics in advance, and their documents were used to cross-check the import quantities calculated. Although some allowance had to be made for applications which did not proceed, these figures confirmed the BSM statistics.

2.4 For future reference, the format of the applications could be extended to include the total weight of active ingredient required, listed in its generic form. This would enable the BFAD to monitor the quantities of common drugs needed in the Philippines on an on-going basis.

2.5 Opinions as to the volume of unrecorded imports vary widely and, whilst our own estimates have been based on discussions with a cross-section of the business community, we have limited confidence in their accuracy.

3. Private Sector Demand

3.1 The statistics compiled by IMS are used widely throughout the industry, despite reservations expressed by all parties concerned as to their accuracy.

3.2 We investigated their sampling methods in detail and believe that the figures produced seriously underestimate the market as a whole. This is primarily because the largest pharmacy chain in the Philippines is excluded and, whilst allowance is made for this, the correction factor would not appear to be adequate. Nevertheless, the IMS figures give an accurate representation of the relative performance of the different brands, and of the year-on-year growth of the market.

3.3 United Laboratories produce their own estimates of private sector demand, but we were unable to assess the accuracy of their survey methods. We therefore have a low degree of confidence in their estimate of market size, but greater reliance can be placed on the time series produced.

4. Public Sector Demand

4.1 The Department of Health purchases for the RHUs comprise the largest element of public sector demand. Based on our analysis of both tenders and actual orders, we have a high level of confidence in these figures.

4.2 Other public purchases are less well documented, but we had enough confidence in the figures available to arrive at an estimate of drug usage in public hospitals.

5. Other Government Statistics

5.1 These mainly comprise social and economic data compiled by the National Statistics Office and morbidity and mortality statistics compiled by the Department of Health. Based on our discussions with the officials involved, we have a high level of confidence in the population estimates and the family expenditure survey, but are less confident as to the accuracy of the population trends and economic forecasts and the health statistics.

APPENDIX 3-10

FORECAST FUTURE DEMAND FOR PENICILLINS

1. Methodology

1.1 The forecast of future domestic demand for penicillins has been built up from the base year of 1990. The growth factor for each drug is composed of two elements :

- estimated population growth over the period; and
- a composite figure which takes into account the various other factors affecting domestic demand.

1.2 The assumptions governing the latter are as follows :

- a gradual but slow improvement in morbidity rates, but only slight improvement in underlying social conditions;
- a gradual rise in living standards;
- an increase in government expenditure on drugs of 1% per year in real terms; and
- a shift in prescription patterns, marking an overall decline in demand for ampicillin and a smaller decline for Pen-V, but steady growth for Pen-G, higher growth for cloxacillin and continuing high growth for amoxycillin.

1.3 All the demand forecasts have been subjected to the test of "reasonableness".

1.4 The model incorporating these factors is detailed in the following table.

Projected Annual Growth Rates per Individual Product

	Population Growth	Other Factors	Total Growth
Pen-G (feedgrade)			
1991 - 1995	2.25%	1.00%	3.25%
1996 - 2000	2.10%	1.00%	3.10%
2001 - 2010	1.90%	1.00%	2.90%
Pen-G (human)			
1991 - 1995	2.25%	3.00%	5.25%
1996 - 2000	2.10%	2.00%	4.10%
2001 - 2010	1.90%	2.00%	3.90%
Pen-V			
1991 - 1995	2.25%	-1.50%	0.75%
1996 - 2000	2.10%	-3.00%	-0.90%
2001 - 2010	1.90%	-5.00%	-3.10%
Ampicillin			
1991 - 1995	2.25%	-4.00%	1.75%
1996 - 2000	2.10%	-5.00%	-2.90%
2001 - 2010	1.90%	-5.00%	-3.10%
Amoxycillin			
1991 - 1995	2.25%	10.00%	12.25%
1996 - 2000	2.10%	5.00%	7.10%
2001 - 2010	1.90%	3.00%	4.90%
Cloxacillin			
1991 - 1995	2.25%	7.00%	9.25%
1996 - 2000	2.10%	7.00%	9.10%
2001 - 2010	1.90%	6.00%	7.90%

Source : Manderstam estimates

2. Projected Growth in Domestic Demand

2.1 Applying the above growth rates to identified demand in 1990 results in the following market projection from 1990 through to the year 2010 (rounded to the nearest tonne) :

Forecast Demand for Penicillins : 1990 - 2010

Tonnes	Pen-G (feed)	Pen-G (human)	Pen-V	Ampi-cillin	Amoxy-cillin	Cloxa-cillin
1990	8	12	24	51	60	8
1991	8	13	24	50	67	9
1992	9	13	24	49	76	10
1993	9	14	25	48	85	10
1994	9	15	25	48	95	11
1995	9	15	25	47	107	12
1996	10	16	25	45	115	14
1997	10	17	24	44	123	15
1998	10	17	24	43	131	16
1999	11	18	24	42	141	18
2000	11	19	24	40	151	19
2001	11	20	23	39	158	21
2002	12	20	22	38	166	22
2003	12	21	22	37	174	24
2004	12	22	21	36	182	26
2005	13	23	20	34	191	28
2006	13	24	20	33	201	30
2007	13	25	19	32	211	33
2008	14	26	19	31	221	35
2009	14	27	18	30	232	38
2010	15	28	17	29	242	41

Source : Manderstam estimates

3. Derived Demand for Pen-G

3.1 Finally, the above figures may be converted to give a derived demand for the basic feedstock material, Pen-G, using the accepted mathematical conversion factors :

Derived Demand for Pen-G : 1990 - 2010

	Pen-G Pen-V	Ampi-cillin	Amoxy-cillin	Cloxa-cillin	Indirect Exports*	Total Pen-G
Factor	1	1.2	1.19	1.05	1.85	
1990	44	61	71	8	-	184
1991	45	60	80	9	-	194
1992	46	59	90	11	-	206
1993	48	58	101	11	30	248
1994	49	58	113	12	60	292
1995	49	56	127	13	90	335
1996	51	54	137	15	96	353
1997	51	53	146	16	103	369
1998	51	52	156	17	110	386
1999	53	50	168	19	118	408
2000	54	48	180	20	126	428
2001	54	47	188	22	132	443
2002	54	46	198	23	139	460
2003	55	44	207	25	146	477
2004	55	43	217	27	153	495
2005	56	41	227	29	161	514
2006	57	40	239	32	168	536
2007	57	38	251	35	177	558
2008	59	37	263	37	185	581
2009	59	36	276	40	194	605
2010	60	35	288	43	204	631

* Bulk Amoxycillin

Source : Manderstam estimates

APPENDIX 3-11

PROJECTED SALES AND MARKET PENETRATION BY PRODUCT

1. Natural Penicillins

Tonnes	Pen-G Feedgrade	Pen-G Pen-V	Total Sales	Forecast Demand	% Market Penetration
1995	2	7	9	49	18%
1996	4	15	19	51	37%
1997	6	22	28	51	55%
1998	8	30	38	51	75%
1999	10	39	49	53	92%
2000	10	39	49	54	91%
2001	10	39	49	54	91%
2002	10	39	49	54	91%
2003	10	40	50	55	91%
2004	10	40	50	55	91%
2005	11	39	50	56	89%
2006	11	40	51	57	89%
2007	11	40	51	57	89%
2008	11	41	52	59	88%
2009	11	41	52	59	88%
2010	11	41	52	60	87%

Data Base : The forecast demand figures are in accordance with the projections which are set out in section 2.1 of Appendix 3-10.

The individual projections in respect of Pen-G (human grade) and Pen-V have been combined as these comprise essentially the same market.

The maximum potential market for the natural penicillins has been forecast at a level which is equivalent to the total market in 1990, plus 50% of the increase projected in each subsequent year.

It has been further assumed that it would take the project five years to achieve these target levels.

PROJECTED SALES AND MARKET PENETRATION BY PRODUCT

2. 6-APA

Tonnes	Total Sales			Forecast Demand	% Market Penetration		
	Option A	Option B	Option C		Option A	Option B	Option C
1995	54	59	65	155	35%	38%	42%
1996	85	95	102	163	52%	58%	63%
1997	101	116	125	172	59%	67%	73%
1998	90	110	120	181	50%	61%	66%
1999	80	106	114	192	42%	55%	59%
2000	98	124	134	202	49%	61%	66%
2001	101	127	139	210	48%	60%	66%
2002	100	126	139	219	46%	58%	63%
2003	98	125	138	228	43%	55%	61%
2004	96	123	138	238	40%	52%	58%
2005	114	141	157	248	46%	57%	63%
2006	116	143	161	259	45%	55%	62%
2007	114	141	161	271	42%	52%	59%
2008	112	140	161	282	40%	50%	57%
2009	109	137	161	295	37%	46%	55%
2010	107	135	161	308	35%	44%	52%

Data Base : The forecast demand figures are in accordance with the projections which are set out in section 3.1 of Appendix 3-10.

The individual market projections in respect of Ampicillin, Amoxycillin and Cloxacillin have each been converted into 6-APA, the basic feedstock material, as have the projections in respect of indirect exports of bulk amoxycillin.

It has been assumed that 6-APA would effectively be a "buffer" product, and that its availability for sale to third parties would be determined by the surplus of actual production over in-house requirements for further processing.

On the basis of the three options under review, this surplus varies significantly according to both the volume and type of production envisaged, as does market penetration :

Option A : 35% to 59%
Option B : 38% to 67%
Option C : 42% to 73%

PROJECTED SALES AND MARKET PENETRATION BY PRODUCT

3. Bulk Semi-Synthetics

Tonnes	Ampi-cillin	Amoxy-cillin	Cloxa-cillin	Total Sales	Forecast Demand	% Market Penetration
1995	5	11	1	17	166	10%
1996	7	17	2	26	174	15%
1997	8	24	3	35	182	19%
1998	10	30	4	44	190	23%
1999	10	35	5	50	201	25%
2000	10	38	5	53	210	25%
2001	10	40	5	55	218	25%
2002	9	42	6	57	226	25%
2003	9	44	6	59	235	25%
2004	9	46	6	61	244	25%
2005	8	48	7	63	253	25%
2006	8	50	8	66	264	25%
2007	8	53	8	69	276	25%
2008	8	55	9	72	287	25%
2009	7	58	10	75	300	25%
2010	7	61	10	78	312	25%

Data Base :

The forecast demand figures are in accordance with the projections which are set out in section 2.1 of Appendix 3-10.

The individual market projections in respect of Amoxycillin, Ampicillin and Cloxacillin have been combined as these are essentially inter-changeable within the market for bulk semi-synthetics.

Market penetration has been forecast at a level equivalent to 10% of the total market in 1995, rising to a maximum of 25% by 1999 and stabilising at 25% thereafter.

APPENDIX 3-12

BRANDS OF AMPICILLIN AND AMOXYCILLIN AVAILABLE IN THE PHILIPPINES

Ampicillin (Brands Ordered by Rank in Market Share)

1.	Ampicin	:	Westmont	*
2.	Pensyn	:	Biomedis	*
3.	Pentrexyl	:	Bristol Labs	*
4.	Penbritin	:	Smithkline Beecham	*
5.	Amopen	:	Mead Johnson	
6.	Specillin	:	Boe Ingelheim	
7.	Omnipen	:	Wyeth Suaco	
8.	Ampedia	:	Pediatrica Lab	
9.	Standacillin	:	Biochemie	
10.	Excillin	:	Servipharm	
11.	Amplivacil	:	Elin Pharm	
12.	Hubbercil	:	Inphilco Pharm	
13.	Ampin	:	Pharma Dynamic Inc	
14.	Ampidan	:	Danlex Lab	
15.	Amplexcillin	:	Doctors Pharm	
16.	Protexillin	:	San Marino	
17.	Amplital	:	C Erba Farmitalia	
18.	Terampicin	:	Terramedic Inc	
19.	Scamicin	:	Scandrug	
20.	Liferzin	:	Health Saver Pharm	
21.	Flexapen	:	E A Northam Pharm	
22.	Chrisolin	:	Christian Pharm	
23.	Leoplex	:	P M S Com	
24.	Cordroxyl	:	Corp Holdings Mgmt	
25.	Amcill	:	Parke Davis	
26.	Amphilex	:	Medicalex Pharm	
27.	Marticil	:	St Martin Pharm	
28.	Moripellin	:	Morshita	
29.	Angypex	:	Charmwood Pharm	
30.	Sylpen	:	Le Jumont Pharm	
31.	Amprobin	:	Servimed	
32.	Emaxin	:	Eadriex	
33.	Philcyllin	:	Philmed Lab	
34.	Kramexcil	:	Kramer	
35.	Apamacin	:	Phil Genethics	
36.	Allidcil	:	Allied	
37.	Pitripen	:	Kinderpharm	
38.	Fampil	:	Spade Pharma	
39.	Sanethillin	:	Sanethical SA	
40.	Avexcillin	:	Avec Pharm	
41.	Drampicillin	:	San Marino	
42.	Eurotrexil	:	Am-Europharma Corp	

* These four brands account for 33% of the total market for Ampicillin

43.	Jerramcil	:	J A R Pharm
44.	Nepogram	:	Lafayette Pharma
45.	Ampimycin	:	Pacific Pharm
46.	Aimelin	:	Compact Pharm
47.	Metadyl	:	Metal Lux
48.	Trilaxin	:	Lejal
49.	Corpen	:	Coronet Lab
50.	Amcillin	:	Regent Pharm
51.	Amdricil	:	Sydenham Lab
52.	Triasyn	:	R B I Pharm
53.	Amprexin	:	Hizon
54.	Bridopen	:	Roddensers Pharm
55.	Biostacil	:	Ad-Drugstel Pharm
56.	Adumic	:	Opsonin Chem Ind
57.	Altapen	:	Bio Strata Pharm

__Amoxycillin__ (Brands Ordered by Rank in Market Share)

1.	Moxillin	:	United American	*
2.	Amoxil	:	Smithkline Beecham	*
3.	Sumoxil	:	Medichem Pharm	*
4.	Himox	:	Westmont	
5.	Polymox	:	Mead Johnson	
6.	Wyamox	:	Wyeth Suaco	
7.	Ampidroxyl	:	Bristol Labs	
8.	Clearamox	:	Boe Ingelheim	
9.	Pediamox	:	Pediatrica Lab	
10.	Robamox	:	Wyeth Suaco	
11.	Penbiosyn	:	Medi Rx Inc	
12.	Servimox	:	Servipharm	
13.	Magnamox	:	E A Northam Pharma	
14.	Amoxsteryl VCP	:	V C P Intermed	
15.	Danmoxin	:	Danlex Lab	
16.	Glenox	:	Glen-Normandy	
17.	Teramoxyl	:	Terramedic Inc	
18.	Essenmox	:	Essenpharma	
19.	Cycamil	:	Kinderpharm	
20.	Britamox	:	Steinbach Products	
21.	Coamoxin	:	Corp Holdings Mgmt	
22.	Stamox	:	Yung Shin Pharma	
23.	Athenalyn	:	Terapico Chemie	
24.	Pharmamox	:	Doctors Pharm	
25.	Dynamoxil	:	Drugmakers Lab	
26.	Jamox	:	Phil Genethics	

* These three brands account for 20% of the total market for Amoxycillin

27	Semoxicillin	:	San Marino
28.	Chrisomox	:	Christian Pharm
29.	Apetruxil	:	Allied
30.	Telsimox	:	Ad-Drugstel Pharm
31.	Syncloxil	:	Le Jumont Pharm
32.	Opixil	:	Nicholas Lab
33.	Pimsylin	:	P M S Com
34.	Ladoxillin	:	Chemex Intl
35.	Grumox	:	Hizon
36.	Filmoxyl	:	Fil Medica
37.	Coroxyllin	:	Coronet Lab
38.	Valmox	:	I A E Pharm
39.	Oramox	:	S V More Pharma
40.	Tynocillin	:	Tynor
41.	Philamox	:	Philmed Lab
42.	Yugoxil	:	Elin Pharm
43.	Bactigent	:	Filadams Pharma
44.	Xyvervex	:	Avec Pharm
45.	Giacillin	:	Compact Pharm
46.	Moxydril	:	Sydenham
47.	Kramollex	:	Kramer
48.	J-Ruxin	:	Coronet Lab
49.	Roximox	:	R B I Pharm
50.	Daisamox	:	Pharmacare Prod

Source : IMS Pacific

APPENDIX 3-13

[illegible]TIVE ORDER NO. 776

[illegible] The Minister of Finance
The Governor, Central Bank of the
Philippines
The Minister of Industry
The Minister of Health
The Commissioner, Bureau of Customs
The Administrator, Food and Drug
Administration

WHEREAS, the promotion of health is a primary national objective [illegible] the attainment of self-sufficiency in materials used in the manufacture of life-saving medicines;

WHEREAS, the establishment in the country of a plant to produce [illegible]-synthetic [illegible] answers a long-felt need to have a reliable local source of semi-synthetic antibiotics, the main ingredients used in the manufacture of life-saving antibiotic medicines;

WHEREAS, [illegible] production, the country is free to act [illegible] from the spread of infectious diseases, thus [illegible] not only its people's health but its national security as well;

WHEREAS, the first Philippine semi-synthetic antibiotics plant [illegible] the gap between the country's rich scientific [illegible] technological knowhow;

WHEREAS, [illegible] contribution to the promotion of health, [illegible] advancement, the semi-synthetic anti-[illegible] plant will [illegible] concrete economic benefits, among which are foreign exchange earnings and savings and the upstream industrialization of the local pharmaceutical industry;

WHEREAS, this plant has an annual production capacity more than adequate to meet not only the domestic consumption requirements but also part of the export demand emanating from some countries in the region;

WHEREAS, the locally-produced semi-synthetic antibiotics are comparable to the imported counterparts in terms of price and quality;

WHEREAS, conscious of the fact that the local production of semi-synthetic antibiotics transcends the narrow confines of a purely business venture and bears directly on the attainment of the national objectives pertaining to health and security, the government has seen it fit to take certain steps that will ensure the viability thereof;

NOW, THEREFORE, I, FERDINAND E. MARCOS, President of the Republic of the Philippines, by virtue of the powers vested in me by the Constitution, do hereby Order and Instruct :

1. The importation of semi-synthetic antibiotics shall be allowed only for quantities and types that cannot be produced in the Philippines. The Central Bank, in consultation with the Board of Investments, Minister of Health and the Food and Drug Administrator, shall issue guidelines regulating such importations.

2. The Collector of Customs shall apprehend all illegal importations of semi-synthetic antibiotics

DONE in the City of Manila, this 24th day of February, 1982, in the year of Our Lord, nineteen hundred and eighty two.

PRESIDENT OF THE PHILIPPINES

By the President:

JOAN C. TUVERA
Presidential Executive Assistant

REPUBLIC OF THE PHILIPPINES
MINISTRY OF HEALTH
FOOD AND DRUG ADMINISTRATION
MANILA

CERTIFIED TRUE COPY

April 30, 1982

ANICETO M. MANAYAN, JR.
Records Officer II
Food and Drug Administration

FDA CIRCULAR
NO. 2 s. 1982

Pursuant to Executive Order No. [illegible], dated February [illegible], 1982, in relation to MAAS No. [illegible] dated November [illegible], 1977, and by way of amendment to FDA Circular dated March 3, 1981, the following rules and procedure for the importation of antibiotics are hereby adopted:

1. All applications for the importation of antibiotics shall be filed with the Food and Drug Administration, and shall contain the following data:

   (a) The name and address of the Agent Bank;
   (b) The name and address of the Importer;
   (c) The country of origin of the antibiotics;
   (d) The generic, chemical, brand/trade name of the product/raw material;
   (e) The form of the antibiotic; and
   (f) The quantity of the antibiotic.

2.
   a) The Food and Drug Administration, with the approval of the Minister of Health, shall issue a certificate of Authority to Import Semi-Synthetic Antibiotics;
   b) The Food and Drug Administration shall issue Certificate of Authority to Import for other Antibiotics.

3. The Certificate of Authority shall be valid for 90 days from date thereof for the purpose of importation and shall be used only once;

4. Each Certificate of Authority to Import should refer to one antibiotic either as finished product or raw materials;

5. The Original copy of the Certificate of Authority to Import shall be submitted to Agent Bank, who shall then furnish FDA, thru CICCO of the Central Bank, with copies of the Letter of Credit/Acceptances issued under this specific authority and the corresponding release certificate issued therefor.

6. The Collector of Customs will allow the release of such importation only upon presentation of the Authority to Import together with all the other requirements in force; and

CERTIFIED TRUE COPY:

ANICETO M. MANAYAN, JR.
Records Officer II
Food and Drug Administration

fda circular
page 2
- - - - - - - -

7. Clearances/certifications issued before February 24, 1982 for ampicillin and amoxycillin under prior FDA Circulars and which have not yet been availed as of the date hereof should be submitted for revalidation.

Manila, Philippines, April 30, 1982.

RECOMMENDING APPROVAL:

CATALINA C. SANCHEZ
Acting Administrator

APPROVED:

J. C. AZURIN
Minister of Health

APPENDIX 3-14

CURRENT TARIFF POLICY IN THE PHILIPPINES

1. Existing Tariff Structure

1.1 At the present time, the Philippines operates tariffs which range from 0% to 50%, the most frequently used rates being 3%, 10%, 20% and 30%. Relatively few products are either zero-rated or are subject to higher rates of up to 50%.

1.2 All pharmaceuticals are classified according to the form in which they are imported : chemically pure bulk, bulk mixtures or final dosage forms. In general terms, the pure chemicals attract a 10% tariff, whilst final dosage forms attract a 20% tariff. Mixed chemicals packed in bulk are generally assessed at either 10% or 20%, all penicillins being subject to the higher tariff rate.

Existing Tariffs as at July 1991

	Chemically Pure Form	Bulk Mixture	Final Dosage Form
Penicillin-G	10%	20%	20%
Penicillin-V	10%	20%	20%
6-APA	3%	*	*
Ampicillin	10%	20%	20%
Amoxycillin	10%	20%	20%
Cloxacillin	10%	20%	20%

* not applicable

Source : Tariff Commisssion - Chemicals Section

2. Protection Measures for Pharmaceutical Industries

2.1 No clear policy has been formulated with regard to the protection of local manufacturers of pharmaceuticals, largely due to the fact that, until now, Chemfields has been the sole domestic producer. However, the National Drug Policy commits the government to the principle of self-sufficiency, and it is reasonable to assume that the tariff structure would be used to assist a new venture in this field, provided it was a genuine pioneer industry.

2.2 On this basis, the first two stages of production, namely, the fermentation of penicillin and manufacture of 6-APA, would be eligible for protection against competing imports.

2.3 The production of bulk semi-synthetics is less clear-cut, in that Chemfields is already producing these products and two additional plants are likely to be established in the near future (HD Pharma and First Pharmaceutical). In this case, it is likely that existing legislation could apply in the initial instance but, in line with world trends, would then be superseded by the introduction of tariff barriers.

2.4 The manufacture of final dosage forms is a thriving industry in the Philippines, and is protected by a differential tariff of 10% on most pharmaceutical products (given that imported final dosage forms are subject to 20% duty, as compared with the 10% duty on bulk chemicals). A new venture would not be given preferential treatment, and would be expected to compete with established companies on the same terms.

Option B : **6-APA**
Bulk Semi-Synthetics
Final Dosage Forms

	Forecast Demand	Surplus for Sale	% Market Penetration
1995	155	59	38%
1996	163	95	58%
1997	172	116	67%
1998	181	110	61%
1999	192	106	55%
2000	202	124	61%
2005	248	141	57%
2010	308	135	44%

Option C : **Natural Penicillins**
6-APA

	Forecast Demand	Surplus for Sale	% Market Penetration
1995	155	65	42%
1996	163	102	63%
1997	172	125	73%
1998	181	120	66%
1999	192	114	59%
2000	202	134	66%
2005	248	157	63%
2010	308	161	52%

5.2 It is anticipated that the shortfall in supply to the three users of 6-APA would be made up by direct imports.

APPENDIX 3-15

ANTICIPATED FUTURE LEVELS OF TARIFF PROTECTION

1. Application for Tariff Preference

1.1 The procedures for establishing a new tariff take a maximum of six months, and can only be set in motion by a bona-fide investor through official channels. The normal procedure is as follows :

a) The initial application for protection is made by the investor to any government agency prepared to support the proposal.

b) This agency requests the change in tariff levels.

c) The investigation carried out by the Tariff Commission in terms of Section 401 of the Tariff and Customs Code, normally involves a public hearing and the submission of position papers by interested parties. The Tariff Commission will then make its recommendation to the National Economic Development Authority.

d) The NEDA Board meets to approve (or modify) the recommendations submitted.

e) The change in rates is finally approved by either the President or Congress, although a limited number of products also have to be referred to GATT.

1.2 No firm indications could be obtained from officials as to what levels of tariff protection could be anticipated for the proposed new production facility. However, some of the likely alternatives were discussed and explored, and the constraints imposed by existing policies were clarified.

2. Option A

2.1 Option A involves the construction of a complete integrated plant using four separate production processes, each of which would merit protection from imported competition. However, the tariff structure does provide constraints in that, in practice, the effective rates in use are 3%, 10%, 20% and 30% only.

2.2 A tariff of 3% on the penicillin culture would have little impact once the production process was underway, given that almost all the material used should be self-generating. However, the initial culture could prove to be expensive, and a special dispensation might have to be sought.

2.3 A tariff barrier would have to be raised at this stage to deter the importation of competing supplies of bulk Pen-G and 6-APA. A rate of 20% would give the new industry adequate protection, and would enable it to establish its sales of Pen-G to such companies as Squibb, Cyanamid and General Milling, and of 6-APA to Chemfields and any other producers of semi-synthetics.

2.4 This, in turn, indicates a higher tariff rate of 30% for the bulk semi-synthetic penicillins produced at the next stage, and for the final dosage forms. These levels would slightly increase the protection afforded to existing industry.

3. Option B

3.1 Option B should allow more flexibility in terms of tariff rates, as it involves only three stages of production.

3.2 In order to minimise the cost of the basic feedstock, the tariff rate on bulk imports of Pen-G would have to be reduced to 3%. As this material cannot be differentiated from the Pen-G brought into the country by such companies as Cyanamid and Squibb, the reduced tariff would also benefit these importers.

3.3 The tariff on 6-APA could then be increased to 20% in order to give the new industry a measure of protection. As in Option A, both bulk semi-synthetics and final dosage forms would be subject to tariffs of 30%.

4. Option C

4.1 Option C only involves the first two production processes.

4.2 Penicillin culture should thus be subject to the lowest tariff rate of 3%, whereas the output of the factory, bulk Pen-G and 6-APA, would both be taxed at 20%.

5. Future Levels of Tariff Protection

	Current Rate	Option A	Option B	Option C
Penicillin Culture	10%	3%	10%	3%
Pen-G Bulk	10%	20%	3%	20%
6-APA	3%	20%	20%	20%
Bulk Semi-Synthetics	10%	30%	30%	*
Final Dosage Forms	20%	30%	30%	*

* not applicable

APPENDIX 3-16

EXPORT MARKET POTENTIAL

1. Introduction

1.1 As has already been noted, there is now a commodity market in most essential drugs which is characterised by high volume production and steadily falling prices. However, the further development of commodity sales is hindered by political considerations, given that many countries regard pharmaceuticals as having a strategic value and have accordingly tried to develop a degree of self-sufficiency in their manufacture.

1.2 Such infant industries are usually given a high level of protection in relation to competition from imports, irrespective of their country of origin. As a result, any export initiative by a new manufacturing plant would have to be accompanied by a political initiative which, in turn, could entail reciprocal agreements.

2. Current Export Trade

2.1 The export trade in penicillins from the Philippines is very limited, with recorded exports over the last decade averaging only $25,000 per year in the case of bulk chemicals and $20,000 per year in that of the final dosage forms. This trade has also been erratic, with relatively large figures being recorded in some years and none at all in others. It is therefore probable that exports resulted from "one-off" decisions by international companies to cover temporary stock shortages in other countries.

2.2 However, we understand that United Laboratories has been active in advising companies outside the Philippines, including the equivalent to Chemfields in Indonesia and a plant for semi-synthetic dosage preparation in Thailand. The involvement of United Laboratories in the ownership of the proposed project could thus provide it with potential trading links, although it must be emphasised that political policies are again likely to have more of an influence on export trade than existing relationships between companies.

3. Relevant Markets

3.1 The ASEAN nations have been a political block for 24 years, but previous efforts at promoting intra-regional trade have been more symbolic that real. As a result, trade between partners has been stagnant at about 20% of total ASEAN trade for a number of years. An attempt is currently being made to create a free trade zone by the year 2000 but, based on past experience, the prospects do not look favourable.

3.2 Despite the foregoing, we believe that the most realistic opportunities for the development of exports lie in the near neighbours of the Philippines, and particularly in the ASEAN countries. These countries fall into three groups :

- Hong Kong, Korea, Singapore and Taiwan all have relatively good health indicators linked with a high per capita GNP, plus well-established and thriving pharmaceutical manufacturing industries.

- At the other end of the scale are some of the poorest countries in the world, notably Cambodia, Lao and Viet Nam (although the latter devotes a high proportion of its limited resources to health).

- Between these two extremes are the middle-ranking countries, which include the Philippines, where life expectancy is fairly high, infant mortality ranges widely and health services are being given a high priority.

Health Indicators of Selected East Asian Countries

	Expectation of Life at Birth in Years	Infant Mortality per 1000 Live Births	Persons per Hospital Bed	Per Capita GNP in US$ (1988)
Philippines	63	38	625	630
Hong Kong	76	9	200	9230
Korea	69	33	588	3530
Singapore	73	9	318	9100
Taiwan	73	7	270	r 'a
Malaysia	70	16	400	1870
Papua New Guinea	53	68	200	770
Thailand	64	43	700	1000
Cambodia	n/a	n/a	893 *	n/a
China	69	35	500	330
Indonesia	55	96	1800	430
Lao PDR	45	151	1130 *	180
Viet Nam	65	13 #	200	n/a

Sources : Asian Development Bank
World Bank

Note : All figures refer to 1985 except
* - 1970
\# - 1980
GNP figures are for 1988

3.3 On balance, we recommend that priority should be given to Indonesia, Thailand and Malaysia as potential export markets (although Singapore and Taiwan could also be regarded as possible collaborative partners). These three countries are similar to the Philippines in terms of the structure of the industry and the health profile of the population, but they do differ in respect of such factors as per capita consumption of drugs in general and anti-infectives in particular.

3.4 Expenditure on drugs in these countries varies widely, with Taiwan and Singapore standing out in terms of sales per head of population :

Consumption of Drugs in Selected Asian Countries : 1990

	Total Market $ million	Population million	Sales per head
Philippines	547.8	60.0	$ 9.13
Indonesia	444.9	179.1	$ 2.48
Thailand	377.7	56.4	$ 6.70
Malaysia *	81.0	17.4	$ 4.66
Singapore *	51.7	2.7	$ 19.15
Taiwan	793.3	20.3	$ 39.08

* Pharmacy sales only

Sources : World Health Organisation
IMS Pacific

3.5 All these countries have relatively free markets for pharmaceuticals, with a large range of licensed drugs available :

Drug Licences in Selected Asian Countries : 1990

	Registered (A) Active Ingredients	Registered (B) Finished Products	Ratio B/A	Essential Drug List
Philippines	800	14000	17.50	560
Indonesia	1319	13645	10.34	387
Thailand	n/a	n/a	n/a	n/a
Malaysia	1019	5079	4.98	644
Singapore	n/a	5154	n/a	377
Taiwan	n/a	n/a	n/a	n/a

Sources : World Health Organisation

3.6 Looking more closely at the consumption of relevant drugs, the following tables show the total market for groups of drugs in overall terms and expressed as consumption per head of population :

Market for Anti-Infectives in Asian Countries : 1990

US$ million	Systemic Anti-Infectives	Antibiotics	Broad Spectrum Penicillins
Philippines	139.2	115.6	39.4
Indonesia	111.2	94.2	38.6
Thailand	79.5	67.8	15.7
Malaysia *	20.0	11.7	3.8
Singapore *	10.2	6.1	1.8
Taiwan	130.9	115.9	16.8

* Pharmacy sales only

Sources : IMS Pacific

3.7 In overall terms, this shows that the largest market for penicillins outside the Philippines is Indonesia, followed by Taiwan and Thailand. However, analysis of the figures on a per capita basis highlights the fact that this expenditure is significantly higher in both Taiwan and Singapore :

Per Capita Consumption of Anti-Infectives 1990

US$ million	Systemic Anti-Infectives	Antibiotics	Broad Spectrum Penicillins
Philippines	2.32	1.93	0.66
Indonesia	0.62	0.53	0.22
Thailand	1.41	1.20	0.28
Malaysia *	1.15	0.67	0.22
Singapore *	3.78	2.26	0.67
Taiwan	6.45	5.71	0.83

* Pharmacy sales only

Sources : IMS Pacific
Asian Development Bank

3.8 On the basis of the information set out in sections 2.4 and 2.6 above, the amount spent per head on broad spectrum penicillins expressed as a proportion of total per capita expenditure on pharmaceutical products may be calculated as follows :

Philippines	7.2%
Indonesia	8.9%
Thailand	4.2%
Malaysia	4.7%
Singapore	3.5%
Taiwan	2.1%

3.9 Contrary to expectation, these variations are not the result of drug prices being higher in certain countries. For example, average market prices quoted for ampicillin are significantly higher in both Indonesia and Singapore relative to Malaysia and the Philippines, whereas procaine benzylpenicillin is far more expensive in Malaysia than in either Indonesia or the Philippines.

4. Export Marketing Strategies

4.1 It is clear that the needs of the domestic market should take precedence over any export potential but, in addition, it is our considered opinion that an extension into the export marketing of the basic raw material feedstock in particular should be deferred until such time as a suitable level of expertise has been developed in this new area of technology.

4.2 It should also be recognised that each of the countries in question is under pressure to increase its self-sufficiency in relation to the production of pharmaceuticals. Consequently a commercial export drive alone is unlikely to be effective. One alternative would be to support United Laboratories, given its close commercial ties with Indonesia, Thailand and Malaysia; another would be to arrange cooperative ventures with private partners at government level.

4.3 Notwithstanding the foregoing, it may be noted that the Board of Investment has recently licensed two new ventures which are to produce semi-synthetic penicillins in competition with Chemfields, on condition that a proportion of their production be exported. This would appear to be at variance with our conclusions but for one factor : namely, that both the companies in question are South Korean-owned and operated, with established trading links throughout Asia.

APPENDIX 3-17

INDIRECT EXPORT POSSIBILITIES

1. **Board of Investment Licences**

1.1 In early 1991, the Board of Investment granted licences to two South Korean companies for the production of bulk amoxycillin in the Philippines. These two companies are :

HD Pharma	:	licensed to produce 68 tonnes of amoxycillin, of which 70% will be exported; and
First Pharmaceutical	:	licensed to produce 54 tonnes of amoxycillin, of which 50% will be exported.

1.2 Because of the relevance of these plans to our own study, we carried out an investigation of both companies.

2. **HD Pharma**

2.1 The shareholders of this company are as follows :

Yong Nam Kim	50,000	=	80%
Seung Huan Yang	12,487	=	20%
Buenventura O Berris	1		
Froilan H Parada	1		
Lina A Asenata	1		
	62,500		

2.2 Initially, the interests of the company were being looked after by Kemexim textiles, but responsibility has now passed to Mr H S Yang, a relative of one of the owners who is normally resident in Makati. Unfortunately, Mr Yang was in South Korea during the period of our investigations, but we were able to discuss the proposals with his staff. It would appear that, owing to delays in registration with the Board of Investment, the company is only now looking for a suitable site, most probably in Laguna. Once a site has been purchased, it is anticipated that HD Pharma would be operational within a period of eighteen months.

3. **First Pharmaceutical**

3.1 This company is also owned/controlled by South Koreans :

Antonio Go Kian Luy	30%
Alexander Go Kian Lin	10%
Makati Supermarket Corporation	20%
Samsung Co (South Korea)	40%
	100%

3.2 The interests of the company are being looked after by a local accountancy practice, LC Diaz and Company. The partner-in-charge was unable to give us specific details as he was bound by the rules of client confidentiality, but he had every reason to believe that the project was being pursued with complete dedication. Once again, a suitable site had yet to be identified, but it was planned that the plant would be on stream by the early part of 1994.

APPENDIX 3-18

DISTRIBUTION LEVELS IN THE PHILIPPINES

1. Level 1 : Brand Owners

1.1 Many of the companies in this category are multinational producers which are based overseas but have subsidiaries in the Philippines (referred to as marketing companies). The importers are predominantly locally-owned companies which purchase their requirements on the world market and bring in the pharmaceuticals either in bulk or in final dosage form :

- Where demand is substantial, the pharmaceuticals are usually imported in bulk for local compounding.

- Given that importation of final dosage forms is more expensive, it is generally limited in volume and/or confined to sophisticated pharmaceuticals which are still protected by patent.

1.2 The majority of the larger companies operate their own packaging or compounding facilities, either in-house or as a separate organisation (for example, General Drug compounds exclusively for the Unilab Group). However, there are also some specialist compounders which undertake sub-contract work for any importer, Interphil being the largest. Further details are set out in the Note to this Appendix.

1.3 About 20 of the 300 or so manufacturers licensed by the Bureau of Food and Drugs (BFAD) account for 80% of the market, the remainder being little more than occasional importers. With the exception of United Laboratories, which controls an estimated 20% of all pharmaceutical sales, no single company has more than a 5% share of the total market.

2. Level 2 : Distributors

2.1 Insofar as the private sector is concerned, distribution is carried out either by the companies themselves or by specialist distributors which handle a portfolio of drugs manufactured by different companies. The largest such distributor is Zuellig, followed by Marsman and Metro.

2.2 The trend is for companies to concentrate their efforts on getting their products specified by the medical profession, and to leave their actual distribution to specialists in this field. We estimate that about two thirds of the drugs on the market are distributed in this way.

2.3 With regard to the public sector, most of the drugs used are purchased by the Department of Health, hence its inclusion in this category. It operates its own drug warehouse and does do some distribution. However, the majority of its purchases are negotiated by annual contract, and hospitals draw off these contracts as required.

3. Level 3 : Retailers

3.1 It is at the retail level that the pattern of distribution becomes most complex :

- A very small proportion of drugs (about 2% to 3%) is sold by doctors direct to their patients, this being generally restricted to the rural areas where there are no pharmacies.

- About 80% of private sector drug sales are routed through the retail pharmacies. Mercury Drug dominates this market with a 40% share of total trade, followed by two smaller chains (Metro and Rose Pharmacy) and a large number of independent operators. There are over 6,000 pharmacies licensed by the BFAD, but only half of these are serviced by the distribution companies. The remainder obtain their supplies from other pharmacies.

- In general terms, the urban centres of the Philippines are better served with retail outlets than the rural areas, a deficiency which the public sector attempts to make up. In particular, the Rural Health Units operate almost exclusively in the rural areas, obtaining their supplies either by direct delivery or from suppliers within the regional chain of command.

- The public sector hospitals operate in a similar fashion, with their requirements being met either by direct delivery or out of Department of Health stocks.

- Government agencies and departments which are not dependent upon the Department of Health budget usually purchase from wholesalers or manufacturers, but are also known to obtain supplies from retail pharmacies.

NOTE TO APPENDIX 3-18

COMPOUNDING AND PACKAGING SECTOR IN THE PHILIPPINES

1. Identified Capacity

1.1 In late 1988, the Board of Investments carried out a survey of existing capacity in the packaging and compounding sector of the pharmaceuticals industry :

	Approximate Capacity	Utilisation in 1988	Excess Capacity
Tablets)	4.4 billion units	33%	67%
Capsules)		43%	57%
Liquids	11 million litres	49%	51%
Creams/Ointments	0.8 million kgs	43%	57%
Vials)	35 million units	86%	14%
Ampoules)		74%	26%
IV Solutions	7 million litres	84%	16%
Suppositories	6 million units	85%	15%

1.2 Of the 33 large facilities in existence, the majority are owned by multinationals, and are used exclusively for processing their own production. Two companies specialise in contract operations (Interphil and Drugmakers), and a further four accept contract work in addition to handling their own products (Marsman, Metro, Hizon and Boie).

2. Planned Developments

2.1 The sector has continued to expand, and two projects in particular have been licensed by the Board of Investment. They are likely to be in production within the next two years. One plant, for Swiss Pharma, is to process 400 tonnes of pharmaceuticals (exact mix unspecified), and the second, for Ashford, is to produce the following :

Tablets	:	600 million units
Capsules	:	100 million units
Injectables	:	2.5 million vials
Eye-Drops	:	3 million vials
Ointments/Creams	:	3 million tubes
Powders	:	1.2 million units
Liquids	:	0.2 million gallons

2.2 It is estimated that these two projects alone will add approximately 25% to existing industry capacity. However, it should also be noted that a degree of over-capacity is inevitable in this sector, given the competitive pressures which prevent multinational companies cooperating through sharing facilities.

APPENDIX 3-19

100 LARGEST DRUG MANUFACTURERS IN THE PHILIPPINES

1. Wyeth Suaco
2. Westmont *
3. Glaxo
4. Abbott
5. Therampharma *
6. United American *
7. Ciba Geigy
8. Boehringer Ingelheim
9. Mead Johnson
10. Astra
11. Parke Davis
12. Biomedis *
13. Medichem Pharm *
14. Smithkline Beecham
15. Myra Pharma *
16. Squibb
17. Pfizer
18. Rhone Poulenc
19. Roche
20. Lederle
21. Schering Plough
22. Sandoz
23. Warner Lambert
24. Nestle
25. Bayer Pharma
26. Wellcome
27. Eli Lilly
28. Winthrop Pharm
29. Janssen Pharm
30. Vicks Products
31. Pediatrica Lab *
32. Bristol Labs
33. Servier
34. Duncan Lab
35. Wander
36. Syntex
37. Johnson
38. Schering Berlin
39. Merck Sharper Dohme
40. International Pharm
41. Upjohn
42. Merck
43. Nutrapharm
44. Boots
45. Searle
46. Hoechst
47. Centramed
48. United Labs *
49. Metro **
50. Imperial Pharma *
51. Nicholas
52. Sonafi
53. Boehringer Marheim
54. Ross
55. C Erba Farmitalia
56. Sterling
57. Takeda
58. Byk Gulden
59. Duphar PV
60. Roussel
61. Knoll
62. Organon
63. Alcon Lab
64. Berna
65. Bernese Alps
66. Tai Sho Pharma
67. UL Generics *
68. USA Generics
69. ICI Pharma
70. Zyma
71. Eaton
72. Hi Esai
73. Purdue Frederick
74. Synthelab
75. Riker Lab
76. Rotta Research Lab
77. E A Northam Pharma **
78. Pasueal Lab **
79. Pasteur
80. YSS
81. Perrelt Corp
82. Otsuka Pharma
83. Miles
84. Servipharm
85. Dispersa
86. Medi-RX **
87. UCB Pharma **
88. Kabivitrum
89. Kali Chemie Duphar
90. VCP International **
91. Corp Holdings Mgmt **
92. Morshita **
93. Stiefel Lab
94. Rhea
95. Shun Yik
96. Newport
97. Asta
98. Scnavo
99. Led Pharma
100. Hisamitsu Pharm

* Unilab subsidiary

** Filipino company

APPENDIX 3-20

TRADE MARGINS IN THE PHILIPPINES

1. Average Distribution Margins

1.1 In 1987, a Department of Health Task Force carried out a comprehensive study to examine the gross profit margins involved in the distribution of pharmaceuticals. This confirmed that, although mark-ups at each of the various stages in the distribution chain are not excessive in percentage terms, they do represent substantial earnings owing to the high value of the product.

1.2 Distributors work on an average mark-up of 15% when selling to wholesalers and retailing pharmacies. In turn, these wholesalers would work on a 5% mark-up when selling to other smaller pharmacies. Finally, the retail mark-up averages 10%. This is summarised below :

	Average Price Index	Average % Mark-Up
Manufacturer to Distributor	100	
Distributor to Wholesaler	115	15
Wholesaler to Retailer	121	5
Retailer to Customer	133	10

1.3 We discussed the margins generally used in the industry with a number of major manufacturers of pharmaceuticals, who confirmed the above figures with one major proviso : namely, that the distribution margins charged also vary according to the volume of business. Thus, high volume drugs, such as semi-synthetic penicillins, usually carry a lower mark-up than small volume, speciality drugs.

1.4 On the basis of these industry guidelines, it would appear that a production plant could expect to earn 75% of the retail price of a drug.

2. Sales and Marketing Costs

2.1 The manufacturers in the Philippines place considerable emphasis on sales and marketing. An academic study carried out amongst drug companies accounting for 60% of the market showed that, whilst specific details varied from company to company, the similarity in their cost structures was remarkable :

	% of Sales
Cost of Goods	50.0 - 60.0
Operating and Selling Costs	31.5 - 36.5
Profits	8.0 - 13.0

2.1 The operating and selling costs can be broken down further to highlight expenditure on selling, product promotion and advertising :

	% of Sales
General Management	4.3 - 12.4
Selling	15.0 - 18.5
Promotion and Advertising	4.5 - 12.4
R & D Royalties	0.5 - 2.5
Interest and Bank Charges	0.3 - 6.0

APPENDIX 3-21

ALTERNATIVE SALES AND MARKETING STRATEGIES

1. Industrial Chemicals

1.1 Natural Penicillins

Most of the Pen-G produced would be used as the basic raw material feedstock for further processing into 6-APA. However, there is also a direct market for both feedgrade and pharmaceutical quality Pen-G :

a) Feedgrade Pen-G could be sold in bulk to animal feed producers or, alternatively, could be further processed into animal feed on-site. On the basis that the latter would involve additional investment in bulk-mixing facilities and expansion into an unrelated area of both production and marketing, it is recommended that the project should concentrate on selling in bulk only.

b) Pharmaceutical quality Pen-G for human use could be sold in bulk to pharmaceutical manufacturers, or in final dosage form direct to the retail market. Given the competition in the latter, it is expected that the company would achieve a higher market penetration by concentrating on selling in bulk only.

1.2 6-APA

With 6-APA, the company would sell part of its output to manufacturers of semi-synthetics but, by keeping the balance for further processing, it would also enter into competition with those producers. However, 6-APA is a commodity and, provided the pricing structure is fair, there should be no conflict in practice.

It is assumed that the tariff structure would provide an element of protection and a limited price incentive for the three potential customers to purchase their requirements locally. In addition, the strategy would be to work closely with those customers in order to support them technically.

It would prove difficult to export 6-APA in the absence of established international connections, and the requisite certification by the USFDA or some similar body.

1.3 Bulk Semi-Synthetics

The market for bulk semi-synthetics is highly competitive, and sales could be compromised by the in-house production of final dosage formulations (Options A and B).

Close relations with government would be essential in order to gain protected status and recognition of indigenous manufacture in government purchasing policies, whilst public relations at doctor level would have to be emphasised.

With three other suppliers of what is a commodity item, the new venture would have to compete on price, by capitalising on the cost advantages inherent in being an efficient and integrated producer. It would also have to offer an exceptional service from the outset in order to make an impact on the market. This would involve technical assistance to customers on an on-going basis, as well as reliable production and administration.

2. **Final Dosage Pharmaceuticals**

2.1 There are currently over 50 brands of ampicillin available in the Philippines, plus a corresponding number of brands of amoxycillin (Appendix 3-12 refers).

2.2 One strategy would be for the company to seek to become one of the dominant brand names. However, this would involve competing against manufacturers with a market reputation built up over 10 to 15 years, and the commitment of at least 25% of anticipated sales revenues to sales development and marketing from Year 1.

2.3 Although the specialist wholesalers are increasingly taking over the distribution function from the drug manufacturers, the latter operate large sales forces to establish and then maintain regular (monthly) contact with prescribing doctors. A new entrant would have to match this, in the face of strong competition from the well-established drugs.

2.4 A more realistic approach would be to rely on government publicity and to concentrate on marketing a realistically priced generic drug. However, this should be accompanied by efforts to secure a change in current policy, whereby government purchases would be confined to semi-synthetics of local origin.

APPENDIX 3-22

MARKETING STRATEGY FOR NATURAL PENICILLINS

FEEDGRADE PENICILLIN

1. **Identified Market**

1.1 Approximately 8 tonnes of feedgrade quality Pen-G are imported into the Philippines each year, primarily by Squibb and Cyanamid, who then sell it on in bulk formulations to animal feed manufacturers. Some of the latter also import directly, including General Milling and Golden Hog Farms, but such purchases tend to be both smaller and less regular.

1.2 Informed opinion has put the potential demand for feedgrade Pen-G at 12 to 14 tonnes per year but, in the absence of any clear evidence to substantiate this, all projections have been based on the identified market figure.

2. **Marketing Strategy Selected**

2.1 Although the new venture could opt to mix its own feed for sale in finished product form, this would involve additional capital expenditure and diversification into a new field of activity. The company should therefore concentrate on bulk sales to the multinational specialists and other animal feed manufacturers.

2.2 If the sales effort is directed towards import substitution as recommended, the potential customers would effectively be limited to four : namely, the two multinationals, Squibb and Cyanamid, plus General Milling and Golden Hog Farms. The project would not have to invest resources in servicing the small feedstuff companies, and this would have an added advantage in that it could then avoid entering into direct competition with its own major customers.

3. **Pricing**

3.1 C&F prices for feedgrade Pen-G averaged about US$ 20 per kg in 1990. Although requirements vary, the multinationals tend to import pure chemical which are subject to a tariff of 10%, whereas the processors import mixtures on which the tariff is 20%. All imports are then subject to additional charges, including insurance, brokerage and bank charges, which can increase the landed cost by as much as 10%.

3.2 If a new tariff level of 20% is assumed, a local producer should be able to compete against imports if it fixed its price at a level equivalent to US$ 25 per kg. This would compare with the typical landed cost of US$ 26 per kg of imported chemical, and would represent a saving of about 4% to the customer on price alone.

3.3 However, the advantages of sourcing from a local supplier also include relatively short delivery times and reduced stocking levels. If these are taken into consideration, it is estimated that purchase of locally produced feedgrade Pen-G could result in a total cost saving of 10% viz-a-viz imported material.

4. Marketing Support

4.1 By following a strict policy on sales strategy, the proposed new venture should be able to establish a sound working relationship with its customer base, in much the same way as Chemfields has achieved. Sales could be handled quite adequately by one top-grade salesman, supported by the sales director and specialist staff to give technical assistance as appropriate. Advertising would not be necessary, but allowance should be made for some expenditure on product seminars and the dissemination of technical literature.

4.2 The total cost of implementing the proposed strategy has been estimated at P 195,000 per annum over the first five years of operation, equivalent to 3% of sales revenue once the company has achieved its forecast market share. This figure may be broken down as follows :

25% of salary cost of salesman	:	P 45,000
25% of vehicle cost of salesman	:	P 20,000
Specialist back-up services	:	P 30,000
End-user product seminars	:	P 60,000
Technical literature	:	P 40,000
Total	:	P 195,000

5. Forecast Market Penetration

5.1 The maximum potential market for feedgrade Pen-G has been forecast at a level which is equivalent to the total market in 1990, plus 50% of all subsequent increases. However, in recognition of the fact that actual sales are unlikely to reach their potential levels until both production and customer acceptance are well established, it has been further assumed that it would take the project five years to achieve these target levels :

	Forecast Demand	Target Sales	Actual Sales	% Market Penetration
1995	9	8	2	18%
1996	10	9	4	40%
1997	10	9	6	60%
1998	10	9	8	80%
1999	11	10	10	91%
2000	11	10	10	91%
2005	13	11	11	85%
2010	15	11	11	73%

5.2 It may be noted that the project is not expected to supply the market in its entirety. This is primarily because there are likely to be some variants of the basic product it would not be economical to manufacture, but it is also to allow for the fact that the multinationals in particular may wish to dual source their supplies for commercial security.

HUMAN GRADE PENICILLIN

1. Identified Market

1.1 Pen-G and Pen-V for human consumption may be treated as a single product in terms of sales and marketing strategy.

1.2 At the present time, about 4 companies import Pen-G and 11 companies import Pen-V, and a further 6 companies bring in both products. This gives a total potential market of 21 companies but, of these, only three import both regularly and in bulk, whilst another 4 or 5 could be described as regular importers. The balance bring in smaller quantities on an ad hoc basis.

2. Marketing Strategy Selected

2.1 The new facility would have the option of either supplying Pen-G in bulk to other pharmaceutical manufacturers, or packaging the product into final dosage forms for supply direct to the retail market. However, the latter would involve considerable expenditure on marketing and, given the extent of competition from the newer and more sophisticated semi-synthetics, would carry a high degree of risk.

2.2 On this basis, and also the fact that the company would not wish to compete directly with its own customers in the end-product market, it is recommended that it should concentrate on selling Pen-G in bulk to established manufacturers. The sales effort would thus be targeted at the eight regular importers, although contact would be made with all companies involved with natural penicillins in order to extend the customer base for the locally produced raw material.

3. Pricing

3.1 The current international price of this grade of penicillin varies considerably depending on the supply situation and the exact formulation for the product. C&F prices ranged from US$ 33 to over US$ 60 per kg in 1990 but, for planning purposes, we have taken US$ 42 per kg as a representative average price.

3.2 Based on the assumed new tariff level of 20%, plus provision for insurance, brokerage, bank charges and other related expenses, the total landed cost of imported Pen-G has been estimated at US$ 55 per kg on average. The local producer should thus be able to compete effectively by setting prices at a level equivalent to US$ 50 per kg, thereby offering a cost advantage of approximately 10% viz-a-viz imports.

4. Marketing Support

4.1 By adopting a strategy of selling to other pharmaceutical companies, it is vitally important that the new venture also provides some guarantee of quality to safeguard its market.

4.2 Although the Philippines operates a system of inspection and licensing for compounders, bulk manufacturing standards have yet to be introduced. The most generally accepted standard is the approval of the USFDA and, without such approval, any company would experience difficulty exporting its product. However, it could also restrict the domestic market, in that neither multinationals nor reputable local companies would be prepared to source from an uncertified producer in the absence of some alternative assurance regarding quality.

4.3 It has therefore been assumed that USFDA approval would be applied for during project implementation, and would be granted soon after the plant commenced operations.

4.4 Given the size of the market, it is anticipated that it could be handled by the same team as would be responsible for marketing feedgrade Pen-G. Once again, high quality technical literature would be needed to support the sales effort, but the main thrust of the marketing campaign would be the organisation of regular factory visits and product seminars for direct customers, doctors and pharmacists.

4.5 The cost of this strategy has been estimated at a total of P 985,000 per annum over the first five years of operation, equivalent to approximately 2% of sales revenue once the company has achieved its forecast market share. This figure may be broken down as follows :

Sales Director	:	P 500,000
75% of salary cost of salesman	:	P 135,000
75% of vehicle cost of salesman	:	P 60,000
Specialist back-up services	:	P 90,000
End-user product seminars/visits	:	P 140,000
Technical literature	:	P 60,000
Total	:	P 985,000

5. <u>Forecast Market Penetration</u>

5.1 As with feedgrade Pen-G, it has been assumed that it would take the project five years to achieve its forecast maximum sales potential for pharmaceutical quality penicillin :

	Forecast Demand	Target Sales	Actual Sales	% Market Penetration
1995	40	39	7	18%
1996	41	39	15	37%
1997	41	39	22	54%
1998	41	39	30	73%
1999	42	39	39	93%
2000	43	39	39	91%
2005	43	39	39	91%
2010	45	41	41	91%

5.2 Once again, the project would not be expected to supply the entire needs of the market, on the basis that some customers would wish to dual source their supplies or to pay a premium to obtain special mixtures.

APPENDIX 3-23

MARKETING STRATEGY FOR 6-APA

1. Identified Market

1.1 The market for 6-APA is limited to those factories which use this as a feedstock for the manufacture of semi-synthetic penicillins. At the present time, Chemfields would be the sole purchaser of 6-APA, but it is anticipated that there would be two additional customers operating by 1995 (namely, HD Pharma and First Pharmaceutical).

2. Marketing Strategy Selected

2.1 It is anticipated that part of the total output of 6-APA would be kept as the basic feedstock material for further processing in-house, and that the balance would be made available for sale. In this way, the proposed project would be competing in the market for semi-synthetics with its potential customers for 6-APA. Whilst such cross-purchasing is not desirable, it is also not uncommon in the chemical industry and, provided the pricing structure is fair, there should be no conflict in practice.

3. Pricing

3.1 The total world requirement for 6-APA is estimated at 17,000 tonnes per year, and 6-APA has become a commodity chemical on the international market. However, almost 90% of this tonnage is manufactured by the multinational companies for their own use. About 2,000 tonnes only are traded on the open market, with the result that any fluctuations in supply can have a dramatic impact on price.

3.2 A more reliable basis is provided by the direct relationship between the cost of Pen-G and that of 6-APA. Given a raw material cost of approximately US$ 45 per kg, and with due provision for conversion/selling costs and a profit margin, the international market price of 6-APA may be estimated at about US$ 60 per kg at the present time. This compares with the price of US$ 50 per kg paid by Chemfields in 1990 when market conditions were more favourable.

3.3 If a new tariff level of 20% is assumed, and the requisite allowance is made for insurance, brokerage, bank charges and other related importation expenses, the total landed cost of 6-APA could rise to as much as US$ 78 per kg. To enable the new venture to offer a discount of at least 10% to 12%, it would be necessary to fix the price of locally produced 6-APA at a level not exceeding US$ 69 per kg.

4. Marketing Support

4.1 The marketing strategy selected assumes that there would be government support for the project through the imposition of new tariff barriers to discourage imports. Thereafter, the company would have to work closely with the three users of 6-APA to ensure that their technical requirements were satisfied.

4.2 Sales and marketing costs would be limited as it would not be necessary to recruit additional specialist staff to cover the limited number of potential customers. Nevertheless, expenditure on technical literature, product promotion and entertainment has been estimated at a total of P 135,000 per annum, broken down as follows :

Technical literature	:	P 15,000
Promotion and entertainment	:	P 120,000
Total	:	P 135,000

5. Forecast Market Penetration

5.1 In view of the fact that 6-APA is effectively the "buffer" product, its availability for sale to third-party clients would be determined by the surplus of production over the company's in-house requirements for further processing. This surplus varies significantly according to both the volume and the type of production envisaged in terms of the three options under review, as does the level of market penetration :

Option A : Natural Penicillins
6-APA
Bulk Semi-Synthetics
Final Dosage Forms

	Forecast Demand	Surplus for Sale	% Market Penetration
1995	155	54	35%
1996	163	85	52%
1997	172	101	59%
1998	181	90	50%
1999	192	80	42%
2000	202	98	49%
2005	248	114	46%
2010	308	107	35%

APPENDIX 3-24

MARKETING STRATEGY FOR BULK SEMI-SYNTHETICS

1. Identified Market

1.1 There are about a dozen regular importers of bulk semi-synthetics whilst, in addition, Chemfields has a further fourteen or so established customers. The market thus comprises a total of about 25 existing companies, plus an unspecified number of occasional importers/buyers.

1.2 In this connection, it is worth noting that some 96% of Chemfields sales are directed to three customers only :

United Laboratories	:	57%
Bristol	:	20%
Interphil	:	19%

Whilst the customer base is much larger, it is thus apparent that it is again dominated by relatively few companies.

2. Marketing Strategy Selected

2.1 It is anticipated that, with implementation of the proposed HD Pharma and First Pharmaceutical projects, there could be three established domestic producers serving the market for bulk semi-synthetics by 1995. This would result in a temporary over-supply situation in the domestic market :

Production Capacity		
Chemfields - existing capacity	:	100 tonnes
- planned expansion	:	30 tonnes
HD Pharma	:	20 tonnes *
First Pharmaceutical	:	27 tonnes *
Total Production Capacity	:	177 tonnes
Identified Market Demand		
Ampicillin	:	47 tonnes
Amoxycillin	:	107 tonnes
Cloxacillin	:	12 tonnes
Total Identified Demand	:	166 tonnes
Excess of Capacity over Demand	:	11 tonnes = 6.6%

* these figures assume that the balance of production (totalling 75 tonnes) would be exported as planned

2.2 In such circumstances, the market could prove very difficult for a new entrant. In particular :

- Chemfields is already firmly established, with a sound reputation for quality, and has the added advantage of being owned by the largest single purchaser of bulk semi-synthetics, United Laboratories; and

- By 1995, the two new companies should also be in full production with a share of the available market.

2.3 However, the proposed project would be the only integrated production process, and it should be able to capitalise on the cost advantages inherent in this. In addition, it should aim to become the major supplier to both Bristol and Interphil, as well as the supplier of second choice to United Laboratories; and to secure a substantial share of government contracts for amoxycillin.

3. Pricing

3.1 In 1990, world prices averaged in the region of US$ 60 per kg for ampicillin, and US$ 65-70 for amoxycillin. The market for cloxacillin is very much smaller, and prices tend to vary more but, as a base, we have used a world price of US$ 90 per kg. With due provision for freight, insurance, brokerage, bank charges, custom duties at the current rate of 10% and other related expenses, the landed cost in the Philippines would be about 20% higher, ranging from US$ 72 per kg for ampicillin to US$ 108 per kg for cloxacillin.

3.2 These prices are considerably lower than those Chemfields has been able to achieve, and which are understood to be in the region of US$ 120 per kg. However, it is unlikely that such high prices could be maintained in the face of growing competition from other domestic producers.

3.3 Based on an assumed new tariff level of 30% for bulk semi-synthetics, it is anticipated that the proposed project should be able to compete against imports if it fixed its prices at the following levels :

Ampicillin	:	US$ 77 per kg
Amoxycillin	:	US$ 90 per kg
Cloxacillin	:	US$ 110 per kg

These prices would represent cost savings to the customer ranging from about 8% to 12.5% viz-a-viz the imported equivalent products.

4. Marketing Support

4.1 The marketing strategy for bulk semi-synthetics assumes that the government would provide some support by introducing higher tariff barriers to encourage purchasing from domestic sources of supply. Additional assistance could then be given by a review of Department of Health purchasing policy, whereby it was specified that all contracts should be based on local supplies of bulk pharmaceuticals.

4.2 Given the extent of competition in the market, the proposed new venture would have to make an impact on the market by offering an exceptional service in terms of technical advice and support, and liaison between factory and customer. It would also have to take steps to raise its profile within the business community and amongst the medical profession by, for example :

- establishing a separate sales office to operate in the commercial capital; and
- designing technical literature and a corporate brochure to supplement a programme of factory visits by doctors in particular.

4.3 Total expenditure on sales and marketing has been estimated at P 1.3 million per annum, broken down as follows :

Technical Sales Manager	:	P 250,000
Vehicle cost	:	P 100,000
Office rental	:	P 250,000
Sales Administrator	:	P 120,000
Secretary/Receptionist	:	P 60,000
Technical literature	:	P 40,000
Corporate brochure	:	P 150,000
Seminars/factory visits	:	P 130,000
Promotion/entertainment	:	P 200,000
Total	:	P 1,300,000

5. Forecast Market Penetration

5.1 One of the problems inherent in the proposal whereby the company would also manufacture final dosage forms (namely, Options A and B) is that this would force it to compete in the market for the latter with those companies which would be its potential customers for the bulk semi-synthetics. It is anticipated that this factor would effectively limit its market share to a maximum of 25%, and that this target level would take up to five years to achieve.

5.2 The proposed build-up in sales and market penetration by individual product is set out below :

Ampicillin

	Forecast Demand	Target Sales	Actual Sales	% Market Penetration
1995	47	12	5	11%
1996	45	11	7	16%
1997	44	11	8	18%
1998	43	11	10	23%
1999	42	10	10	25%
2000	40	10	10	25%
2005	34	8	8	25%
2010	29	7	7	25%

Amoxycillin

	Forecast Demand	Target Sales	Actual Sales	% Market Penetration
1995	107	27	11	10%
1996	115	29	17	15%
1997	123	31	24	20%
1998	131	33	30	23%
1999	141	35	35	25%
2000	151	38	38	25%
2005	191	48	48	25%
2010	242	61	61	25%

Cloxacillin

	Forecast Demand	Target Sales	Actual Sales	% Market Penetration
1995	12	3	1	8%
1996	14	4	2	14%
1997	15	4	3	20%
1998	16	4	4	25%
1999	18	5	5	25%
2000	19	5	5	25%
2005	28	7	7	25%
2010	41	10	10	25%

APPENDIX 3-25

MARKETING STRATEGY FOR FINAL DOSAGE FORMS

1. Identified Market

1.1 The market for the main semi-synthetic penicillins is both fiercely competitive and dominated by well-established brand names.

1.2 This point is clearly illustrated in Appendix 3-12, which lists the 50 or so brands of ampicillin and amoxycillin which were available in the Philippines in 1990. The list is ranked in order of market share and, in each case, it may be noted that the first three or four names alone account for a significant proportion of the total broad spectrum market :

Ampicillin

Ampicin	:	Westmont	)
Pensyn	:	Biomedis	) approx 33%
Pentrexyl	:	Bristol Laboratories	)
Penbritin	:	Smithkline Beecham	)

Amoxycillin

Moxillin	:	United American	)
Amoxil	:	Smithkline Beecham	) approx 20%
Sumoxil	:	Medichem Pharmacy	)

1.3 The remainder of the market is divided between a very large number of minor brand names, the majority of which supply less than 1% of total demand.

2. Marketing Strategy Selected

2.1 From the point of view of market strategy, it would be a mistake to attempt to become one of the dominant brand names, as this would involve competing against market leaders with an established reputation. It would also be necessary to commit a minimum of 25% of anticipated sales revenues to sales development and marketing expenses on an on-going basis (and an even higher proportion in the early years of operation).

2.2 In addition, it may be noted that, whilst the larger drug companies are increasingly handing over their distribution function to specialist distributors, they now emphasise direct contact with prescribing doctors on a regular basis. A new entrant would have to match this, in the face of stiff competition from the comparatively well-known semi-synthetic brand names.

2.3 A more realistic approach would be to concentrate on the generic market, given that the reduction in the marketing expenses involved should more than compensate for the lower prices which generic products command viz-a-viz brand names. This would also enable the company to capitalise on the publicity which government is giving to the generic drugs campaign in the Philippines. As the concentration will be on supplying the generic market, it will be more cost effective to concentrate on the high volume products, particularly capsules and suspensions. The specialist products such as drops and injectables can be considered for inclusion at a later date but only when the mainstream products have been established and accepted by the market.

2.4 Finally, reference should be made to the fact that the main thrust of the marketing strategy would be to establish a steady regular supply to the private sector. Although the government market is substantial, its requirements are met by annual tender in terms of which individual contracts may be awarded to a number of firms. In these circumstances, it is not possible to predict the extent to which a new supplier could secure such government business.

3. Pricing

3.1 In order to clearly demonstrate the cost advantages of a generic product, it has been assumed that prices would be set at a clear discount relative to the market leader.

3.2 The following prices have been calculated by reference to manufacturers trade prices : that is, the price to retail outlets less the standard wholesale discount and excluding VAT at 10%. To be consistent, all prices are shown in US$ terms and per kg of active ingredient :

- The first four columns detail the price per kg of the market leader in each of the four most common forms, capsules, syrups/suspensions, drops and injectables.

- The average column is a weighted average which makes allowance for the different mix of dosage forms identified in the course of this study :

	Capsules	Suspensions	Drops	Injectables
Ampicillin	70%	5%	5%	20%
Amoxycillin	70%	20%	5%	5%
Cloxacillin	70%	20%	-	10%

- The last column gives our suggested average price for the generic product, allowing a clear differential of 40% relative to the market leader price.

Drug	Capsules	Syrup/ Suspension	Drops	Inject-ables	Average Price	Generic Price
Ampicillin	413	944	1,161	3,574	1,109	665
Amoxycillin	735	1,200	1,312	5,101	1,075	645
Cloxacillin	673	1,574	-	4,599	1,246	750

3.3 However, it is anticipated that the proposed plant would concentrate on the production of capsules and syrups/powders in the initial instance at least. Based on the foregoing, the prices charged in Peso per kg would be as follows :

			Market Leader	Generic Price
Ampicillin	:	Capsules	10,738	6,443
	:	Syrups	24,544	14,726
Amoxycillin	:	Capsules	19,110	11,466
	:	Syrups	31,200	18,720
Cloxacillin	:	Capsules	17,498	10,500
	:	Syrups	40,924	24,554

4. Marketing Support

4.1 The marketing strategy for final dosage forms assumes that the company would distribute to the private sector via one or more of the established specialist wholesalers, such as Zuellig, Marsman, Metro or Philusa. However, in order to guarantee that the new product is promoted to the maximum extent possible, it may be necessary to offer additional incentives over and above the normal trade terms in the form of preferential discounts. These are likely to average at least 2.5%, calculated by reference to gross sales revenues.

4.2 In addition, the company would operate a national sales force to make direct contact with prescribing doctors and pharmacies and to bring the product to their attention. The total fixed cost of this has been estimated at P 6.4 million per annum over the first five years of operation, equivalent to approximately 12.5% of sales revenue once the company has achieved its forecast market share. This figure may be broken down as follows :

Sales Director	:	P	500,000
National Sales Manager	:	P	250,000
3 x Sales Supervisors	:	P	540,000
25 x Sales Representatives	:	P	3,600,000
Vehicle costs	:	P	440,000
National office rental	:	P	300,000
2 x Regional office rentals	:	P	200,000
4 x Secretaries	:	P	140,000
4 x Clerical staff	:	P	120,000
Receptionist	:	P	25,000

Technical literature	:	P	60,000
Corporate brochure	:	P	150,000
Seminars/factory visits	:	P	100,000
Total	:	P	6,425,000

4.3 Finally, the nature of the final dosage market is such that further provision should be made for expenditure on medical advertising and extensive product promotion/entertainment. This has been calculated at 5% of total sales revenues in each year, to give the following breakdown of costs over the first five years of the life of the project (in P '000) :

	1995	1996	1997	1998	1999
Sales Revenues	10,079	21,413	30,128	40,677	51,226
2.5% Discounts	252	535	753	1,017	1,281
Sales Costs	6,425	6,425	6,425	6,425	6,425
Promotion etc.	504	1,071	1,506	2,034	2,561
	7,181	8,031	8,684	9,476	10,267
% of Revenues	71%	37%	29%	23%	20%

5. Forecast Market Penetration

5.1 In view of the extent of competition in the market, it is anticipated that the project would be unable to secure more than a 2% share of the market for final dosage products, and that even this target level would take up to five years to achieve. The proposed build-up in sales and maximum market penetration by individual product is set out below :

Ampicillin

	Forecast Demand	Target Sales	Actual Sales	% Market Penetration
1995	47	0.9	0.2	0.4%
1996	45	0.9	0.4	0.9%
1997	44	0.9	0.6	1.4%
1998	43	0.9	0.7	1.6%
1999	42	0.8	0.8	1.9%
2000	40	0.8	0.8	2.0%
2005	34	0.7	0.7	2.0%
2010	29	0.6	0.6	2.0%

Amoxycillin

	Forecast Demand	Target Sales	Actual Sales	% Market Penetration
1995	107	2.1	0.5	0.5%
1996	115	2.3	1.2	1.0%
1997	123	2.5	1.6	1.3%
1998	131	2.6	2.2	1.7%
1999	141	2.8	2.8	2.0%
2000	151	3.0	3.0	2.0%
2005	191	3.8	3.8	2.0%
2010	242	4.8	4.8	2.0%

Cloxacillin

	Forecast Demand	Target Sales	Actual Sales	% Market Penetration
1995	12	0.2	0.1	0.8%
1996	14	0.3	0.1	0.7%
1997	15	0.3	0.2	1.3%
1998	16	0.3	0.3	1.9%
1999	18	0.4	0.4	2.2%
2000	19	0.4	0.4	2.1%
2005	28	0.6	0.6	2.1%
2010	41	0.8	0.8	2.0%

APPENDIX 3-26

PROJECTED SALES REVENUES BY INDIVIDUAL PRODUCT

1. Natural Penicillins

in P '000

	Feedgrade Pen-G		Human Grade Pen-G		Total Sales Revenues
	Tonnage	Value	Tonnage	Value	
1995	2	1,300	7	9,100	10,400
1996	4	2,600	15	19,500	22,100
1997	6	3,900	22	28,600	32,500
1998	8	5,200	30	39,000	44,200
1999	10	6,500	39	50,700	57,200
2000	10	6,500	39	50,700	57,200
2001	10	6,500	39	50,700	57,200
2002	10	6,500	39	50,700	57,200
2003	10	6,500	40	52,000	58,500
2004	10	6,500	40	52,000	58,500
2005	11	7,150	39	50,700	57,850
2006	11	7,150	40	52,000	59,150
2007	11	7,150	40	52,000	59,150
2008	11	7,150	41	53,300	60,450
2009	11	7,150	41	53,300	60,450
2010	11	7,150	41	53,300	60,450

Data Base : The forecast sales figures are in accordance with the projections set out in Appendix 3-11.

It has been assumed that the natural penicillins would be sold at the following prices :

Feedgrade Pen-G : P 650 per kg
Clinical Grade Pen-G : P 1,300 per kg

PROJECTED SALES REVENUES BY INDIVIDUAL PRODUCT

2. 6-APA

in P '000

	Option A		Option B		Option C	
	Tonnage	Value	Tonnage	Value	Tonnage	Value
1995	54.0	96,876	58.9	105,667	65.4	117,328
1996	84.5	151,593	94.7	169,892	102.2	183,347
1997	101.5	182,091	116.7	209,360	125.4	224,968
1998	89.9	161,281	110.4	198,058	120.0	215,280
1999	79.7	142,982	106.2	190,523	114.1	204,695
2000	97.6	175,094	124.1	222,635	134.1	240,575
2001	101.1	181,373	127.5	228,735	138.9	249,187
2002	99.7	178,862	126.2	226,403	138.9	249,187
2003	97.8	175,453	124.9	224,071	138.4	248,290
2004	96.4	172,942	123.5	221,559	138.4	248,290
2005	113.5	203,619	140.5	252,057	156.8	281,299
2006	115.8	207,745	143.4	257,260	161.1	289,013
2007	113.8	204,157	141.3	253,492	161.1	289,013
2008	111.2	199,493	139.4	250,084	160.5	287,937
2009	109.2	195,905	137.3	246,316	160.5	287,937
2010	107.2	192,317	135.3	242,728	160.5	287,937

Data Base : The forecast sales figures are in accordance with the projections set out in Appendix 3-11, which were rounded to the nearest tonne.

It has been assumed that 6-APA would be sold at the following price :

6-APA : P 1,794 per kg

PROJECTED SALES REVENUES BY INDIVIDUAL PRODUCT

3. Bulk Semi-Synthetics

in P '000

	Ampicillin		Amoxycillin		Cloxacillin		Total Sales Revenues
	Tonnage	Value	Tonnage	Value	Tonnage	Value	
1995	5	10,010	11	25,740	1	2,860	38,610
1996	7	14,014	17	39,780	2	5,720	59,514
1997	8	16,016	24	56,160	3	8,580	80,756
1998	10	20,020	30	70,200	4	11,440	101,660
1999	10	20,020	35	81,900	5	14,300	116,220
2000	10	20,020	38	88,920	5	14,300	123,240
2001	10	20,020	40	93,600	5	14,300	127,920
2002	9	18,018	42	98,280	6	17,160	133,458
2003	9	18,018	44	102,960	6	17,160	138,138
2004	9	18,018	46	107,640	6	17,160	142,818
2005	8	16,016	48	112,320	7	20,020	148,356
2006	8	16,016	50	117,000	8	22,880	155,896
2007	8	16,016	53	124,020	8	22,880	162,916
2008	8	16,016	55	128,700	9	25,740	170,456
2009	7	14,014	58	135,720	10	28,600	178,334
2010	7	14,014	61	142,740	10	28,600	185,354

Data Base : The forecast sales figures are in accordance with the projections set out in Appendix 3-11.

It has been assumed that the bulk semi-synthetics would be sold at the following prices :

Bulk Ampicillin	:	P 2,002 per kg
Bulk Amoxycillin	:	P 2,340 per kg
Bulk Cloxacillin	:	P 2,860 per kg

PROJECTED SALES REVENUES BY INDIVIDUAL PRODUCT

4. Final Dosage Semi-Synthetics

in P '000

	Ampicillin		Amoxycillin		Cloxacillin		Total Sales
	Tonnage	Value	Tonnage	Value	Tonnage	Value	Revenues
1995	0.2	1,786	0.5	6,821	0.1	1,472	10,079
1996	0.4	3,571	1.2	16,370	0.1	1,472	21,413
1997	0.6	5,357	1.6	21,828	0.2	2,943	30,128
1998	0.7	6,249	2.2	30,013	0.3	4,415	40,677
1999	0.8	7,142	2.8	38,198	0.4	5,886	51,226
2000	0.8	7,142	3.0	40,927	0.4	5,886	53,955
2001	0.8	7,142	3.2	43,655	0.4	5,886	56,683
2002	0.9	8,035	3.3	45,019	0.4	5,886	58,940
2003	0.7	6,249	3.5	47,748	0.5	7,358	61,355
2004	0.7	6,249	3.7	50,476	0.5	7,358	64,083
2005	0.7	6,249	3.8	51,841	0.6	8,830	66,920
2006	0.7	6,249	4.0	54,569	0.6	8,830	69,648
2007	0.6	5,357	4.2	57,297	0.7	10,301	72,955
2008	0.6	5,357	4.4	60,025	0.7	10,301	75,683
2009	0.6	5,357	4.6	62,755	0.8	11,773	79,885
2010	0.6	5,357	4.8	65,483	0.8	11,773	82,613

Data Base : The forecast sales figures are in accordance with the projections set out in Appendix 3-11.

It has been assumed that the final dosage forms would be sold at the following prices :

Ampicillin Capsules : P 6,443 per kg
Ampicillin Syrups : P 14,726 per kg

Amoxycillin Capsules : P 11,466 per kg
Amoxycillin Syrups : P 18,720 per kg

Cloxacillin Capsules : P 10,500 per kg
Cloxacillin Syrups : P 24,554 per kg

It has also been assumed that approximately 70% of the production of each semi-synthetic would be sold in the form of capsules, and the remaining balance of 30% in the form of syrups/suspensions.

APPENDIX 3-27

PROJECTED SALES REVENUES BY MANUFACTURING OPTION

1. Option A

in P '000

	Natural Penicillins	6-APA	Bulk Semi-Synthetics	Dosage Forms	Total Revenues
1995	10,400	96,876	38,610	10,079	155,965
1996	22,100	151,593	59,514	21,413	254,620
1997	32,500	182,091	80,756	30,128	325,475
1998	44,200	161,281	101,660	40,677	347,818
1999	57,200	142,982	116,220	51,226	367,628
2000	57,200	175,094	123,240	53,955	409,489
2001	57,200	181,373	127,920	56,683	423,176
2002	57,200	178,862	133,458	58,940	428,460
2003	58,500	175,453	138,138	61,355	433,446
2004	58,500	172,942	142,818	64,083	438,343
2005	57,850	203,619	148,356	66,920	476,745
2006	59,150	207,745	155,896	69,648	492,439
2007	59,150	204,157	162,916	72,955	496,178
2008	60,450	199,493	170,456	75,683	506,082
2009	60,450	195,905	178,334	79,885	514,574
2010	60,450	192,317	185,354	82,613	520,734

2. Option B

in P '000

	Natural Penicillins	6-APA	Bulk Semi-Synthetics	Dosage Forms	Total Revenues
1995	-	105,667	38,610	10,079	154,356
1996	-	169,892	59,514	21,413	250,819
1997	-	209,360	80,756	30,128	320,244
1998	-	198,058	101,660	40,677	340,395
1999	-	190,523	116,220	51,226	357,969
2000	-	222,635	123,240	53,955	399,830
2001	-	228,735	127,920	56,683	413,338
2002	-	226,403	133,458	58,940	418,801
2003	-	224,071	138,138	61,355	423,564
2004	-	221,559	142,818	64,083	428,460
2005	-	252,057	148,356	66,920	467,333
2006	-	257,260	155,896	69,648	482,804
2007	-	253,492	162,916	72,955	489,363
2008	-	250,084	170,456	75,683	496,223
2009	-	246,316	178,334	79,885	504,535
2010	-	242,728	185,354	82,613	510,695

PROJECTED SALES REVENUES BY MANUFACTURING OPTION

3. Option C

in P '000

	Natural Penicillins	6-APA	Bulk Semi-Synthetics	Dosage Forms	Total Revenues
1995	10,400	117,328	-	-	127,728
1996	22,100	183,347	-	-	205,447
1997	32,500	224,968	-	-	257,468
1998	44,200	215,280	-	-	259,480
1999	57,200	204,695	-	-	261,895
2000	57,200	240,575	-	-	297,775
2001	57,200	249,187	-	-	306,387
2002	57,200	249,187	-	-	306,387
2003	58,500	248,290	-	-	306,790
2004	58,500	248,290	-	-	306,790
2005	57,850	281,299	-	-	339,149
2006	59,150	289,013	-	-	348,163
2007	59,150	289,013	-	-	348,163
2008	60,450	287,937	-	-	348,387
2009	60,450	287,937	-	-	348,387
2010	60,450	287,937	-	-	348,387

APPENDIX 3-28

PROJECTED SALES COSTS BY MANUFACTURING OPTION

1. Option A

in P '000

	Manpower	Product Promotion	Travel	Office Rental	Sales Commissions	Total Costs
1995	6,285	1,889	620	750	252	9,796
1996	6,285	2,456	620	750	535	10,646
1997	6,285	2,891	620	750	753	11,299
1998	6,285	3,419	620	750	1,017	12,091
1999	6,285	3,946	620	750	1,281	12,882
2000	6,285	4,083	620	750	1,349	13,087
2001	6,285	4,219	620	750	1,417	13,291
2002	6,285	4,332	620	750	1,474	13,461
2003	6,285	4,453	620	750	1,534	13,642
2004	6,285	4,589	620	750	1,602	13,816
2005	6,285	4,731	620	750	1,673	14,059
2006	6,285	4,867	620	750	1,741	14,263
2007	6,285	5,033	620	750	1,824	14,512
2008	6,285	5,169	620	750	1,892	14,716
2009	6,285	5,379	620	750	1,997	15,031
2010	6,285	5,516	620	750	2,065	15,236

2. Option B

in P '000

	Manpower	Product Promotion	Travel	Office Rental	Sales Commissions	Total Costs
1995	6,285	1,469	620	750	252	9,376
1996	6,285	2,036	620	750	535	10,226
1997	6,285	2,471	620	750	753	10,879
1998	6,285	2,999	620	750	1,017	11,671
1999	6,285	3,526	620	750	1,281	12,462
2000	6,285	3,663	620	750	1,349	12,667
2001	6,285	3,799	620	750	1,417	12,871
2002	6,285	3,912	620	750	1,474	13,041
2003	6,285	4,033	620	750	1,534	13,222
2004	6,285	4,169	620	750	1,602	13,426
2005	6,285	4,311	620	750	1,673	13,639
2006	6,285	4,447	620	750	1,741	13,843
2007	6,285	4,613	620	750	1,824	14,092
2008	6,285	4,749	620	750	1,892	14,296
2009	6,285	4,959	620	750	1,997	14,611
2010	6,285	5,096	620	750	2,065	14,816

PROJECTED SALES COSTS BY MANUFACTURING OPTION

3. Option C

in P '000

	Manpower	Product Promotion	Travel	Office Rental	Sales Commissions	Total Costs
1995	680	555	80	-	-	1,315
1996	680	555	80	-	-	1,315
1997	680	555	80	-	-	1,315
1998	680	555	80	-	-	1,315
1999	680	555	80	-	-	1,315
2000	680	555	80	-	-	1,315
2001	680	555	80	-	-	1,315
2002	680	555	80	-	-	1,315
2003	680	555	80	-	-	1,315
2004	680	555	80	-	-	1,315
2005	680	555	80	-	-	1,315
2006	680	555	80	-	-	1,315
2007	680	555	80	-	-	1,315
2008	680	555	80	-	-	1,315
2009	680	555	80	-	-	1,315
2010	680	555	80	-	-	1,315

NOTE TO APPENDIX 3-28

PROJECTED SALES COSTS BY INDIVIDUAL PRODUCT

1. Natural Penicillins, 6-APA and Bulk Semi-Synthetics

in P '000

	Manpower	Product Promotion	Travel and Transport	Office Rental	Sales Commiss-ions	Total Sales Costs
Pen-G)	680	420	80	-	-)	1,315
6-APA)		135			)	
Bulk Product	430	520	100	250	-	1,300

2. Final Dosage Forms

in P '000

	Manpower	Product Promotion	Travel and Transport	Office Rental	Sales Commiss-ions	Total Sales Costs
1995	5,175	814	440	500	252	7,181
1996	5,175	1,381	440	500	535	8,031
1997	5,175	1,816	440	500	753	8,684
1998	5,175	2,344	440	500	1,017	9,476
1999	5,175	2,871	440	500	1,281	10,267
2000	5,175	3,008	440	500	1,349	10,472
2001	5,175	3,144	440	500	1,417	10,676
2002	5,175	3,257	440	500	1,474	10,846
2003	5,175	3,378	440	500	1,534	11,027
2004	5,175	3,514	440	500	1,602	11,231
2005	5,175	3,656	440	500	1,673	11,444
2006	5,175	3,792	440	500	1,741	11,648
2007	5,175	3,958	440	500	1,824	11,897
2008	5,175	4,094	440	500	1,892	12,101
2009	5,175	4,304	440	500	1,997	12,416
2010	5,175	4,441	440	500	2,065	12,621

Data Source : Appendices 3-22 to 3-25 inclusive

APPENDIX 3-29

PENICILLIN PRICING

1. Nature of the International Market

1.1 Bulk pharmaceuticals are commodities and are traded as such internationally. However they differ from the commodities in a number of ways so it is not possible to chart a single base price as is possible with commodities such as gold or oil.

1.2 There are far fewer buyers and sellers of these chemical commodities so the market (and particularly pricing) is opaque rather than transparent. Although buyers may discuss general trends in pricing they will not disclose the exact prices that they pay because of commercial confidentiality.

1.3 There is a basic grade of each pharmaceutical but this only accounts for a very small proportion of the market. It is a non-sterile crude grade and needs further processing and/or additional additives before it can be used for animals or for humans. Each of these processes adds to the cost.

1.4 Grades manufactured in a factory which is accredited by an internationally acceptable body such as the FDA can charge a premium over and above equivalent grades from a non-certified factory.

1.5 Pharmaceutical products have a limited shelf life so long term storage is not possible. This can distort the supply and demand equation in the short term.

2. Structure of the International Market

2.1 Generic pharmaceuticals are obtainable from four different sources.

2.2 Once a patented drug has passed out of patent the original patent holder normally continues to make the chemical for its own use. Because of its production experience over time it will almost certainly be the most efficient producer in the first few years. Most of the production will be traded internally with its subsidiaries but a proportion is usually available for third parties.

2.3 Large manufacturers who specialise in generic products manufacture off-patent drugs for sale to any buyers.

2.4 Increasingly factories in developing countries such as India, China and Brazil are selling part of their production on the international market. These factories were established to serve their domestic market but they reserve part of their production for the international market in order to earn foreign exchange.

2.5 A network of independent traders, mainly based in Europe, has grown up to handle smaller quantities of bulk chemicals as well as final dosage forms. These traders often act as the agents of the bulk producers and deal exclusively with companies requiring quantities of less than one or two tonnes. (Larger customers usually deal direct with the factory).

3. Price Fluctuations

3.1 Fine chemical production is part of the chemical industry and like the chemical industry it suffers from periodic shortages and surpluses which result in price changes. These imbalances of capacity are caused by several producers making similar decisions at the same time. In times of shortage several producers may make investment decisions to boost capacity at about the same time. This new capacity all comes on stream at once and the market is temporarily in surplus so prices drop. This in turn forces manufacturers to review their production plans and they may take simultaneous decisions to close down some of their older plants. Consequently production drops, there is a shortage in the market and prices rise.

3.2 The last time this happened in the penicillin market was in 1984-1986. Penicillin prices from 1980 to 1984 were weak which inhibited investment in new plants. Within a period of six months in 1985 crude Pen G went from $13 per BU to $28 per BU. This was caused by three major producers coinciding in having production problems.

a) Beecham were short of capacity for their own use and their new capacity was late coming on stream. They therefore entered the market as buyers.

b) Gist Brocades, another major manufacturer, had an infection problem and was not able to supply some of their regular contracts,

c) Glaxo took the decision to change their process and in the course of doing this, they has contamination problems.

Within a further six months these problems were sorted out and prices dropped rapidly to their former levels.

3.3 There are currently indications that we are experiencing another upward cycle in pricing. Prices during 1991 were originally about $13 per BU for crude Pen G but they gradually drifted upwards to $15 towards the end of the year. The latest price we have been able to obtain is $16.25 and this is only guaranteed for thirty days. In other words the supplier is expecting prices to rise more.

This shortage has arisen because of disruption in Eastern Europe and other constraints on capacity elsewhere in the world. Several factories in Eastern Europe have reduced output because of internal political and financing problems. In addition a brand new factory in former East Germany has been closed down and sold to an intermediary. In China, national output of bulk penicillin has been reduced by 180 tonnes because of obsolete plants although the official reason given is decreasing domestic demand and rising imports.

4. Price Trends

4.1 All the penicillin based products covered by this report are sensitive to changes in the price of Pen G because of the direct relationship between the raw material, the intermediates and the finished products.

4.2 Despite the price fluctuations described in the previous section the price of the crudest form of Pen G has stayed stable over time at between $13 per BU and $15 per BU. This translates into a price between $20.73 per kg and $23.92 per kg.

4.3 Because it stays constant in dollar terms, the price is effectively falling in real terms because of the effects of inflation. However, if a local currency such as the peso depreciates against the dollar over the same period this reduction in price may be negated.

5. Pen G Prices

5.1 The imports of bulk Pen G into the Philippines were examined for three years, 1988-1990. There were of course variations caused mainly by the following factors:

a) Large purchasers (say over 1 tonne) pay less for their supplies than small purchasers.

b) More sophisticated mixtures such as fine powder cost more than crude mixtures. Similarly varieties such as procaine cost more than the basic sodium and potassium salts.

c) Multinationals tend to pay more on a like for like basis than independent companies because they normally source from their parent company or an FDA accredited supplier.

d) Prices included CIF charges and sometimes CIF charges. These have been allowed for in our calculations by deducting 10% from the dollar value.

5.2 Over the three years the average prices and the range between low and high prices was as follows:

Year	Low Price	High Price	Average Price
1988	25.12	54.13	40.38
1989	24.30	61.55	39.19
1990	16.51	65.09	34.41

5.3 Superficially it appears that the average price has been gradually falling over the period but this is because the proportion of large buyers has increased and because indigenous companies now account for a higher proportion of purchases.

5.4 The mix however results in more extremes between high and low prices. The Philippines market is becoming more sophisticated and is requiring more expensive products but at the same time formulation is also becoming more sophisticated as it can buy cruder chemicals and process them into higher value added forms.

5.5 We therefore adopted a market level for the international price of crude Pen G at $20 per kilo. This does not mean that the price will always be at that level, it will fluctuate both up and down. However, over the period 1995 - 2010 we believe it is a reasonable average price.

5.6 Similarly we have adopted $40 for the price of a medium quality clinical grade mixture, typical of the requirements of the Philippines manufacturers.

5.7 These two prices would have to be raised by CIF costs plus a tariff to calculate a landed price in the Philippines.

	World Price	CIF Costs	Tariff	Landed Cost
Feed Grade	$20	+10%	+20%	27.80
Clinical Mixture	$40	+10%	+20%	55.60

5.3 These landed costs would allow us to set prices for domestically produced Pen G at $25 and $50 respectively, thus giving a 10% advantage over imported chemicals.

6. 6-APA Prices

6.1 6-APA prices are directly dependent upon Pen G prices as this is the major raw material.

6.2 Assuming a price of $13.00 to $13.50 per BU, the raw material cost for 1kg of 6-APA would be about $40.

6.3 Efficient plants can process 6-APA for $3.00 per kilo whereas inefficient plants cost about $10 per kilo. We assume a medium price of $7 per kilo.

6.4 Selling costs of 5% and a profit of 10% would take the world price to $53 - $56 per kilo.

6.5 This compares with the average price paid by Chemfields of:-

1988	$64.97
1989	$58.45
1990	$49.81

Although this short time series appears to show the price consistently dropping, it has risen again during 1992 and is currently about $61 per kilo.

6.6 Consequently we feel confident in setting an average world price for 6-APA of $55 over the period 1995 - 2010. There will however be considerable fluctuations in that price, both up and down.

6.7 A world price at this level would imply a landed cost in the Philippines of about $76.77 per kilo.

World Price	$55
CIF	+10%
Tariff	+20%
Landed Price	$76.70

6.8 This price would allow the domestic producers to sell at about $69 per kilo in order to give them a 10% margin over imports.

7. Bulk Semi-Synthetics

7.1 As with 6-APA the bulk chemical prices are directly dependent upon the price of raw penicillin.

7.2 In the last six months ampicillin has moved from a price of \$48 to \$70 and amoxycillin has shown a similar jump from \$55 to \$73 as the world has moved from surplus to shortage.

7.3 Some of the reasons for this have already been explained but in addition the last US producer has closed down, reducing the world capacity by about 500 tonnes.

7.4 Again it is difficult to set an average price for the next twenty years but we believe that the following levels are realistic.

Ampicillin	\$54
Amoxycillin	\$63
Cloxacillin	\$77

7.5 Using these as base prices the landed cost in the Philippines can be calculated and the price for domestic production set at a discount of 10%.

	World Price	CIF	Tariff	Landed Cost	Domestic Price
Ampicillin	\$54	+10%	+30%	\$ 85.50	\$ 77
Amoxycillin	\$63	+10%	+30%	\$100.00	\$ 90
Cloxacillin	\$77	+10%	+30%	\$122.00	\$110

APPENDIX 3-30 PRODUCTION SCHEDULE/SALES FORECAST

Production Schedule (converted into Pen-G equivalent) : Option A

	Natural Penicillins	Pen-G Feed	Pen-G / Pen-V Human	6-APA	Bulk S-Synths	Ampi-cillin	Amoxy-cillin	Cloxa-cillin	Final Dosage	Ampi-cillin	Amoxy-cillin	Cloxa-cillin	Total Pen-G
1995	9	2	7	100.1	20	6	13	1	0.9	0.2	0.5	0.1	130
1996	19	4	15	157	30	8	20	2	2	0.5	1.4	0.1	208
1997	28	6	22	187.2	42	10	23	3	2.5	0.7	1.9	0.2	260
1998	30	8	30	150.2	52	12	36	4	3.7	0.8	2.5	0.3	269
1999	49	10	33	117.5	53	12	42	5	4.7	1	3.3	0.4	290
2000	45	10	33	151	57	12	45	5	5	1	3.5	0.4	297
2001	49	10	39	195.8	55	12	48	5	5.2	1	3.8	0.4	306
2002	49	10	38	154.7	67	11	50	5	5.3	1	3.9	0.4	306
2003	50	10	40	181.5	69	11	52	6	5.5	0.8	4.2	0.5	306
2004	50	10	40	179.3	72	11	55	6	5.7	0.8	4.4	0.5	305
2005	50	11	39	210.1	74	10	57	7	5.9	0.8	4.5	0.6	340
2006	51	11	49	213.8	79	10	60	8	6.2	0.8	4.8	0.6	349
2007	51	11	40	210.5	81	10	63	8	6.4	0.7	5	0.7	345
2008	52	11	41	206.4	84	10	65	9	6.6	0.7	5.2	0.7	349
2009	52	11	41	202	88	8	59	11	7	0.7	5.5	0.8	343
2010	52	11	41	157.8	92	9	73	11	7.2	0.7	5.7	0.8	349

Sales Forecast by Individual Product : Option A

	Natural Penicillins	Pen-G Feed	Pen-G / Pen-V Human	6-APA	Bulk S-Synths	Ampi-cillin	Amoxy-cillin	Cloxa-cillin	Final Dosage	Ampi-cillin	Amoxy-cillin	Cloxa-cillin
1995	9	2	7	54	17	5	11	1	0.8	0.2	0.5	0.1
1996	19	4	15	85	26	7	17	2	1.7	0.4	1.2	0.1
1997	28	6	22	101	35	8	24	3	2.4	0.6	1.6	0.2
1998	30	8	30	90	44	10	30	4	3.2	0.7	2.2	0.3
1999	49	10	33	[illegible]	[illegible]	10	35	5	4	0.8	2.3	0.4
2000	45	10	33	[illegible]	53	10	38	5	4.2	0.8	3	0.4
2001	49	10	33	101	55	10	40	5	4.4	0.8	3.2	0.4
2002	49	10	35	100	57	9	42	6	4.5	0.8	3.3	0.4
2003	50	10	40	98	59	9	44	6	4.7	0.7	3.5	0.5
2004	50	10	40	96	61	9	46	6	4.9	0.7	3.7	0.5
2005	50	11	39	[illegible]	63	9	48	7	5.1	0.7	3.8	0.6
2006	51	11	40	116	66	9	50	8	5.3	0.7	4	0.6
2007	51	11	40	114	69	8	53	8	5.5	0.6	4.2	0.7
2008	52	11	41	112	72	9	55	9	5.7	0.6	4.4	0.7
2009	52	11	41	109	75	[illegible]	58	10	6	0.6	4.6	0.8
2010	52	11	41	107	79	[illegible]	61	10	6.2	0.6	4.8	0.8

Production Schedule (converted into Pen-G equivalent) : Option B

	Natural Penicillins	Pen-G Feed	Pen-G / Pen-V Human	6-APA	Bulk S-Synths	Ampi-cillin	Amoxy-cillin	Cloxa-cillin	Final Dosage	Ampi-cillin	Amoxy-cillin	Cloxa-cillin	Total Pen-G
1995	0	0	0	109.1	20	6	13	1	0.9	0.2	0.6	0.1	130
1996	0	0	0	176	30	8	20	2	2	0.5	1.4	0.1	208
1997	0	0	0	215.2	42	10	29	3	3.3	0.7	1.9	0.2	260
1998	0	0	0	204.0	52	12	36	4	3.7	0.8	2.6	0.3	266
1999	0	0	0	196.3	59	12	42	5	4.7	1	3.3	0.4	269
2000	0	0	0	230	[illegible]	12	45	5	5	1	3.5	0.4	297
2001	0	0	0	235.8	65	12	48	5	5.2	1	3.8	0.4	306
2002	0	0	0	233.7	67	11	50	6	5.3	1	3.9	0.4	306
2003	0	0	0	231.5	69	11	52	6	5.5	0.8	4.2	0.5	306
2004	0	0	0	228.3	72	11	55	6	5.7	0.8	4.4	0.5	306
2005	0	0	0	250.1	74	10	57	7	5.9	0.8	4.5	0.6	340
2006	0	0	0	254.3	78	10	60	8	6.2	0.8	4.8	0.6	349
2007	0	0	0	261.6	81	10	63	8	6.4	0.7	5	0.7	349
2008	0	0	0	258.4	84	10	65	9	6.5	0.7	5.2	0.7	349
2009	0	0	0	254	88	8	69	11	7	0.7	5.5	0.8	349
2010	0	0	0	249.9	92	8	73	11	7.2	0.7	5.7	0.8	349

Sales Forecast by Individual Product : Option B

	Natural Penicillins	Pen-G Feed	Pen-G / Pen-V Human	6-APA	Bulk S-Synths	Ampi-cillin	Amoxy-cillin	Cloxa-cillin	Final Dosage	Ampi-cillin	Amoxy-cillin	Cloxa-cillin
1995	0	0	0	53	17	5	11	1	0.8	0.2	0.5	0.1
1996	0	0	0	95	26	7	17	2	1.7	0.4	1.2	0.1
1997	0	0	0	112	35	8	24	3	2.4	0.6	1.6	0.2
1998	0	0	0	110	44	10	30	4	3.2	0.7	2.2	0.3
1999	0	0	0	106	50	10	35	5	4	0.8	2.8	0.4
2000	0	0	0	124	53	10	38	5	4.2	0.8	3	0.4
2001	0	0	0	127	55	10	40	5	4.4	0.8	3.2	0.4
2002	0	0	0	125	57	9	42	6	4.5	0.8	3.3	0.4
2003	0	0	0	125	59	9	44	6	4.7	0.7	3.5	0.5
2004	0	0	0	123	61	8	46	6	4.9	0.7	3.7	0.5
2005	0	0	0	141	63	8	48	7	5.1	0.7	3.8	0.6
2006	0	0	0	143	66	8	50	8	5.3	0.7	4	0.6
2007	0	0	0	141	69	8	53	8	5.5	0.6	4.2	0.7
2008	0	0	0	143	72	8	55	9	5.7	0.5	4.4	0.7
2009	0	0	0	137	75	7	58	10	6	0.6	4.6	0.8
2010	0	0	0	135	78	7	61	10	6.2	0.6	4.8	0.8

Production Schedule (converted into Pen-G equivalent) : Option C

	Natural Penicillins	Pen-G Feed	Pen-G / Pen-V Human	6-APA	Bulk S-Synths	Ampi-cillin	Amoxy-cillin	Cloxa-cillin	Final Dosage	Ampi-cillin	Amoxy-cillin	Cloxa-cillin	Total Pen-G
1995	9	2	7	121	0	0	0	0	0	0	0	0	139
1996	19	4	15	180	0	0	0	0	0	0	0	0	209
1997	28	5	22	202	0	0	0	0	0	0	0	0	260
1998	28	8	30	222	0	0	0	0	0	0	0	0	260
1999	49	10	39	211	0	0	0	0	0	0	0	0	260
2000	49	10	39	243	0	0	0	0	0	0	0	0	297
2001	49	10	39	257	0	0	0	0	0	0	0	0	306
2002	49	10	39	257	0	0	0	0	0	0	0	0	306
2003	50	10	40	255	0	0	0	0	0	0	0	0	306
2004	50	10	40	256	0	0	0	0	0	0	0	0	306
2005	50	11	39	290	0	0	0	0	0	0	0	0	340
2006	51	11	40	293	0	0	0	0	0	0	0	0	349
2007	51	11	40	293	0	0	0	0	0	0	0	0	349
2008	52	11	41	297	0	0	0	0	0	0	0	0	349
2009	52	11	41	297	0	0	0	0	0	0	0	0	349
2010	52	11	41	297	0	0	0	0	0	0	0	0	349

Sales Forecast by Individual Product : Option C

	Natural Penicillins	Pen-G Feed	Pen-G / Pen-V Human	6-APA	Bulk S-Synths	Ampi-cillin	Amoxy-cillin	Cloxa-cillin	Final Dosage	Ampi-cillin	Amoxy-cillin	Cloxa-cillin
1995	9	2	7	65	0	0	0	0	0	0	0	0
1996	15	4	15	102	0	0	0	0	0	0	0	0
1997	23	5	22	115	0	0	0	0	0	0	0	0
1998	33	8	30	120	0	0	0	0	0	0	0	0
1999	49	10	39	114	0	0	0	0	0	0	0	0
2000	49	10	39	134	0	0	0	0	0	0	0	0
2001	49	10	39	129	0	0	0	0	0	0	0	0
2002	49	10	39	133	0	0	0	0	0	0	0	0
2003	50	10	40	138	0	0	0	0	0	0	0	0
2004	50	10	40	138	0	0	0	0	0	0	0	0
2005	50	11	39	157	0	0	0	0	0	0	0	0
2006	51	11	40	161	0	0	0	0	0	0	0	0
2007	51	11	40	161	0	0	0	0	0	0	0	0
2008	52	11	41	161	0	0	0	0	0	0	0	0
2009	52	11	41	161	0	0	0	0	0	0	0	0
2010	52	11	41	161	0	0	0	0	0	0	0	0

BASE DATA ASSUMPTIONS : OPTION A

Option A		Year	1995	1996	1997	1998	1999
PENICILLIN FERMENTATION	batcnes		51	81	101	101	101
Fermentation Materials -	kg per batch						
Corn Steep Liquor	60,633		3092.3	4911.3	6123.9	6123.9	6123.9
Calcium Carbonate	15,157		773.0	1227.7	1530.9	1530.9	1530.9
Sodium Sulphate	9,549		487.0	773.5	964.4	964.4	964.4
Potassium Hydrogen Phosphate	909		46.4	73.6	91.8	91.8	91.8
Soy Bean Oil	4,729		241.2	383.0	477.6	477.6	477.6
Ammonium Sulphate	7,650		390.2	619.7	772.7	772.7	772.7
Ammonia Gas	940		47.9	76.1	94.9	94.9	94.9
Sulphuric Acid	1,440		73.4	116.6	145.4	145.4	145.4
Soy Bean Oil	1,260		64.3	102.1	127.3	127.3	127.3
Sucrose Solution	50,400		2570.4	4082.4	5090.4	5090.4	5090.4
Phenyl Acetic Acid Salt	9,900		504.9	801.9	999.9	999.9	999.9
Penicillin Extraction							
Butyl Acetate	5,530		282.0	447.9	558.5	558.5	558.5
Active Carbon	16.65		0.8	1.3	1.7	1.7	1.7
Sodium Bicarbonate	809		41.3	65.5	81.7	81.7	81.7
Butanol	2,390		121.9	193.6	241.4	241.4	241.4
Utilities -	Units per batch						
Steam - tons	120		6,120	9,720	12,120	12,120	12,120
Power - Mwh	279		14,227	22,595	28,174	28,174	28,174
Water - cu.metres	135		6,885	10,935	13,635	13,635	13,635

				1995	1996	1997	1998	1999
Fermentation Costs Factor :	1.0		Total	67,879	107,802	134,423	134,423	134,423
------------------			Local	43,382	68,901	85,913	85,913	85,913
Corn Steep Liquor	8,900			27,521	43,711	54,503	54,503	54,503
Calcium Carbonate	7,020	*		5,426	8,618	10,747	10,747	10,747
Sodium Sulphate	3,796	*		1,849	2,936	3,661	3,661	3,661
Potassium Hydrogen Phosphate	51,792	*		2,403	3,812	4,755	4,755	4,755
Soy Bean Oil	21,000			5,065	8,043	10,030	10,030	10,030
Ammonium Sulphate	683	*		267	423	528	528	528
Ammonia Gas	4,784	*		229	364	454	454	454
Sulphuric Acid	910	*		67	106	132	132	132
Soy Bean Oil	21,000			1,350	2,144	2,673	2,673	2,673
Sucrose Solution	3,675			9,446	15,003	18,707	18,707	18,707
Phenyl Acetic Acid Salt	28,236	*		14,256	22,642	28,233	28,233	28,233
Extraction Costs Factor :	1.0			15,661	24,871	31,015	31,015	31,015

Butyl Acetate	39,000	*		10,998	17,468	21,782	21,782	21,782
Active Carbon	25,896	*		21	34	44	44	44
Sodium Bicarbonate	22,906	*		946	1,500	1,871	1,871	1,871
Butanol	30,316	*		3,696	5,869	7,318	7,318	7,318
Cost of Utilities Factor :	1.0			35,277	56,029	69,862	69,862	69,862

Steam	600			3,672	5,832	7,272	7,272	7,272
Power	2,220			31,583	50,162	62,547	62,547	62,547
Water	3.17			22	35	43	43	43
Raw Material Cost per kg			Pesos	642.62	637.85	636.30	636.30	636.30
			US $	24.72	24.53	24.47	24.47	24.47

Option A		Year	1995	1996	1997	1998	1999
6-APA PRODUCTION	tonnes		65	102	125	120	114
Production Materials -	per tonne						
Pen-G			121.0	189.0	232.0	222.0	211.0
Amidase	0.005		0.33	0.51	0.63	0.60	0.57
Dichloromethane	6		390.0	612.0	750.0	720.0	684.0
Ammonia	1.5		97.5	153.0	187.5	180.0	171.0
Hydrochloric Acid 30%	2		130.0	204.0	250.0	240.0	228.0
Acetone	2.5		162.5	255.0	312.5	300.0	285.0
Production Costs Factor :	1.0		15,033	23,589	28,909	27,753	26,366
Pen-G	0		0	0	0	0	0
Amidase	0		0	0	0	0	0
Dichloromethane	23,530 *		9,177	14,400	17,648	16,942	16,095
Ammonia	4,940 *		482	756	926	889	845
Hydrochloric Acid 30%	2,340 *		304	477	585	562	534
Acetone	31,200 *		5,070	7,956	9,750	9,360	8,892
Cost of Utilities Factor :	1.0						
Steam/Power/Water	5,450		354	556	681	654	621
Raw Material Cost per kg		Pesos	1427.53	1413.17	1412.24	1408.43	1408.99
		US $	54.91				

Option A		Year	1995	1996	1997	1998	1999
BULK AMPICILLIN	tonnes		5.2	7.4	8.6	10.7	10.8
Production Materials -	kg per tonne						
6-APA	-		3.4	4.8	5.6	6.9	7.0
Acetone	680		3.5	5.0	5.8	7.3	7.3
Dichloromethane	960		5.0	7.1	8.3	10.3	10.4
Methyl Iso Butyl Ketone	400		2.1	3.0	3.4	4.3	4.3
Triethylamine	340		1.8	2.5	2.9	3.6	3.7
Ethylchlorocarbonate	372		1.9	2.8	3.2	4.0	4.0
Phenylglycine	491		2.6	3.6	4.2	5.3	5.3
Potassium Hydroxide	172		0.9	1.3	1.5	1.8	1.9
Ethanol	156		0.8	1.2	1.3	1.7	1.7
Ethylacetoacetate	440		2.3	3.3	3.8	4.7	4.8
Production Costs Factor :	1.0		3,420	4,844	5,605	7,027	7,061
6-APA	0		0	0	0	0	0
Acetone	31,200 *		109	156	181	228	228
Dichloromethane	23,530 *		118	167	195	242	245
Methyl Iso Butyl Ketone	40,560 *		85	122	138	174	174
Triethylamine	101,270 *		182	253	294	365	375
Ethylchlorocarbonate	452,400 *		860	1,267	1,448	1,810	1,810
Phenylglycine	665,600 *		1,731	2,396	2,796	3,528	3,528
Potassium Hydroxide	126,620 *		114	155	190	228	241
Ethanol	30,732 *		25	37	40	52	52
Ethylacetoacetate	85,020 *		196	281	323	400	408
Cost of Utilities Factor :	1.0						
Steam/Power/Water	81,500		424	603	701	872	880
Raw Material Cost per kg		Pesos	1591.08	1571.24	1571.35	1564.97	1567.03
		US $	61.20				

Option A		Year	1995	1996	1997	1998	1999
BULK AMOXYCILLIN	tonnes		11.5	18.2	25.6	32.2	37.8
Production Materials -	kg per tonne						
6-APA	-		7.4	11.7	16.5	20.7	24.3
Acetone	700		8.1	12.7	17.9	22.5	26.5
Dichloromethane	960		11.0	17.5	24.6	30.9	36.3
Methyl Iso Butyl Ketone	400		4.6	7.3	10.2	12.9	15.1
Triethylamine	330		3.8	6.0	8.4	10.6	12.5
Ethylchlorocarbonate	360		4.1	6.6	9.2	11.6	13.6
Phenylglycine	551		6.3	10.0	14.1	17.7	20.8
Potassium Hydroxide	183		2.1	3.3	4.7	5.9	6.9
Ethanol	166		1.9	3.0	4.2	5.3	6.3
Ethylacetoacetate	470		5.4	8.6	12.0	15.1	17.8
Production Costs Factor :	1.0		7,915	12,595	17,693	22,248	26,137
6-APA	0		0	0	0	0	0
Acetone	31,200	*	253	396	558	702	827
Dichloromethane	23,530	*	259	412	579	727	854
Methyl Iso Butyl Ketone	40,560	*	187	296	414	523	612
Triethylamine	101,270	*	385	608	851	1,073	1,266
Ethylchlorocarbonate	452,400	*	1,855	2,986	4,162	5,248	6,153
Phenylglycine	665,600	*	4,193	6,656	9,385	11,781	13,844
Potassium Hydroxide	126,620	*	266	418	595	747	874
Ethanol	30,732	*	58	92	129	163	194
Ethylacetoacetate	85,020	*	459	731	1,020	1,284	1,513
Cost of Utilities Factor :	1.0						
Steam/Power/Water	81,500		937	1,483	2,086	2,624	3,081
Raw Material Cost per kg		Pesos	1606.85				
		US $	61.80				

Option A		Year	1995	1996	1997	1998	1999
BULK CLOXACILLIN	tonnes		1.1	2.1	3.2	4.3	5.4
Production Materials -	kg per tonne						
6-APA	-		0.6	1.2	1.8	2.4	3.1
Acetone	1,250		1.4	2.6	4.0	5.4	6.8
Methyl Iso Butyl Ketone	2,500		2.8	5.3	8.0	10.8	13.5
Acid Chloride	714		0.8	1.5	2.3	3.1	3.9
Sodium Hydroxide	116		0.1	0.2	0.4	0.5	0.6
Sodium Hexanoate	480		0.5	1.0	1.5	2.1	2.6
Production Costs Factor :	1.0		833	1,590	2,443	3,319	4,146
6-APA	0		0	0	0	0	0
Acetone	31,200 *		44	81	125	168	212
Methyl Iso Butyl Ketone	40,560 *		114	215	324	438	548
Acid Chloride	546,000 *		437	819	1,256	1,693	2,129
Sodium Hydroxide	251,160 *		25	50	100	126	151
Sodium Hexanoate	425,490 *		213	425	638	894	1,106
Cost of Utilities Factor :	1.0						
Steam/Power/Water	48,200		53	101	154	207	260
Raw Material Cost per kg		Pesos	1625.13				
		US $	62.51				

Option A		Year	1995	1996	1997	1998	1999
FINAL DOSAGE FORMS	tonnes		0.8	1.7	2.4	3.2	4.0
Capsules - Percentage	70		0.6	1.2	1.7	2.2	2.8
Syrups - Percentage	30		0.2	0.5	0.7	1.0	1.2
Packaging Costs Factor :	1.0		761	1,668	2,351	3,179	3,940
Capsules	783,354 *		470	940	1,332	1,723	2,193
Syrups	1,456,000 *		291	728	1,019	1,456	1,747
Cost of Utilities Factor :	1.0						
Steam/Power/Water	350,000		280	595	840	1,120	1,400

4-2

		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2004	2005	2006	[illegible]	2008	2009
[illegible] %	89												[illegible]	149	149	149	149
[illegible]	[illegible]																
											[illegible]	[illegible]	140.0	49.0	149.0	149.0	149.0
Maltase		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.92	0.95	0.95	0.95	0.95
Dichloromethane		[illegible]	[illegible]	342.0	342.0	346.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1104.0	1134.0	1134.0	1134.0	1134.0
Ammonia	[illegible]	105.0	135.0	211.5	211.5	211.5	241.5	247.5	247.5	247.5	247.5	276.0	283.5	283.5	283.5	283.5
Hydrochloric acid 30%		[illegible]	[illegible]	[illegible]	252.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	330.0	368.0	378.0	378.0	378.0	378.0
Acetone	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	412.5	[illegible]	[illegible]	460.0	472.5	472.5	472.5	472.5
Production costs Factor :		[illegible]	[illegible]	[illegible]	201,5[illegible]	[illegible]	[illegible]264	[illegible]	[illegible]	[illegible]	[illegible]	263,553	[illegible]	270,560	270,560	270,560
Taxes	300,[illegible]	[illegible]	[illegible]	157,000	169,[illegible]	169,[illegible]	[illegible]	136,[illegible]	[illegible]	[illegible]	[illegible]	221,000	226,850	226,850	226,850	226,850
Maltase											6	0	0			
Dichloromethane	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25,977	26,683	26,683	26,663	26,663
Ammonia	[illegible]	[illegible]	[illegible]	[illegible]	[illegible],45	1,045	[illegible]	[illegible]	[illegible]	[illegible]	1,223	1,363	1,400	1,400	1,400	1,400
Hydrochloric acid 30%	[illegible]	[illegible]	524	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	861	885	885	885	885
Acetone	[illegible]	[illegible]	[illegible]	15,998	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible],870	[illegible]	14,352	14,742	14,742	14,742	14,742
Cost of utilities Factor :	[illegible]															
Steam-Power water	1,450	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	999	1,063	1,030	1,030	1,030	1,030
Raw Material Cost per kg	Pesos	1430.43	1430.41	1429.85	1429.85	1429.85	1430.34	[illegible]	[illegible]	[illegible]	[illegible]	1432.35	1431.53	1431.53	1431.53	1431.53
	[illegible]	55.32														

[illegible]		Year	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2004	2005	2006	2007	2008	2009
[illegible]	tonnes		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Consumption Materials	kg per tonne																
[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Acetone	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Methyl iso butyl ketone	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]																	
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Potassium hydroxide	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]																
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Raw Material Cost per kg		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

per tonne	
Acetone	[illegible]
Methyl isobutyl ketone	[illegible]
Triethylamine	[illegible]
Ethylchlorocarbonate	[illegible]
Phenylglycine	[illegible]
Potassium hydroxide	[illegible]
Ethanol	[illegible]
Acetone	[illegible]
Methyl isobutyl ketone	[illegible]
Triethylamine	[illegible]
Phenylglycine	[illegible]
Potassium hydroxide	[illegible]
Ethanol	[illegible]
Process water	[illegible]

Option A		Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
BULK CLOXACILLIN	tonnes		1.1	2.1	3.2	4.3	5.4	5.4	5.4	6.4	6.5	6.5	7.6	8.6	8.7	9.7	10.8
Production Materials -	kg per tonne																
6-APA	[illegible]		0.6	1.2	1.8	2.4	[illegible]	[illegible]	[illegible]	[illegible]	3.7	3.7	4.3	4.9	4.9	5.5	6.1
Acetone	1,250		1.4	2.6	4.0	5.4	6.8	6.8	6.8	8.0	8.1	8.1	9.5	10.8	10.9	12.1	13.5
Methyl Iso Butyl ketone	2,500		2.6	5.3	8.0	10.8	13.5	13.5	13.5	16.0	16.3	16.3	19.0	21.5	21.8	24.3	27.0
Acid Chloride	714		0.8	1.5	2.3	3.1	3.9	3.9	3.9	4.6	4.6	4.6	5.4	6.1	6.2	6.9	7.7
Sodium Hydroxide	[illegible]		0.1	0.2	0.4	0.5	0.6	0.6	0.6	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.3
Sodium Hexanoate	480		0.5	[illegible]	1.5	2.1	[illegible]	2.6	[illegible]	[illegible]	3.1	3.1	3.6	4.1	4.2	4.7	5.2
Production Costs	Factor : [illegible]		533	1,550	2,443	3,315	4,146	4,146	4,146	4,906	4,946	4,946	5,773	6,536	6,647	7,407	8,260
6-APA			[illegible]	[illegible]	0	0	[illegible]	0	[illegible]	[illegible]	0	0	0	0	0	0	0
Acetone	31,2[illegible] $		44	51	125	158	212	212	212	250	253	253	296	337	340	378	421
Methyl Iso Butyl ketone	40,500 $		114	215	324	470	548	548	548	644	661	661	771	872	884	986	1,095
Acid Chloride	546,000 $		437	919	1,256	1,693	2,129	2,129	2,124	2,512	2,512	2,512	2,940	3,331	3,385	3,767	4,204
Sodium Hydroxide	51,[illegible] $		25	50	100	126	151	151	[illegible]	[illegible]	201	201	226	251	251	276	327
Sodium Hexanoate	425,[illegible] $		217	425	638	894	1,106	1,106	1,106	1,319	1,319	1,319	1,532	1,745	1,787	2,000	2,213
Cost of utilities	Factor : 1.0																
Steam-Power-Water	40,200		53	[illegible]	154	207	[illegible]	[illegible]	260	306	313	313	366	415	419	468	521
Raw Material Cost per kg		Pesos	1629.02														
		US $	62.65														

Option B		Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
FINAL DOSAGE FORMS	tonnes		0.8	1.7	2.4	3.2	4.0	4.2	4.4	4.6	4.7	4.9	5.1	5.3	5.5	5.7	6.0
Capsules - Percentage	[illegible]		0.6	1.2	1.7	2.2	2.8	2.9	3.1	3.2	3.3	3.4	3.6	3.7	3.9	4.0	4.2
Syrups - Percentage	[illegible]		0.2	0.5	0.7	1.0	1.2	1.3	1.3	1.4	1.4	1.5	1.5	1.6	1.6	1.7	1.8
Packaging Costs	Factor : [illegible]		761	1,668	2,351	3,179	[illegible]	4,165	[illegible]	4,545	[illegible]	4,847	5,004	5,228	5,385	5,608	5,911
Capsules	95,254 $		470	940	1,272	[illegible]	2,149	[illegible]	2,428	2,501	2,585	2,663	2,820	2,898	3,055	3,133	3,290
Syrups	1,456,[illegible] $		291	728	1,019	1,456	1,747	1,893	1,893	2,038	2,038	2,184	2,184	2,330	2,330	2,475	2,621
Cost of Utilities	Factor : [illegible]																
Steam-Power-Water	350,[illegible]		350	495	840	1,120	1,400	[illegible]	1,540	1,610	1,645	1,715	1,785	1,855	1,925	1,995	2,100

Option A	1995	1996	1997	1998	1999
Maximum Possible Output (Pen-G)	286	286	286	286	286
Capacity Utilisation	45.5%	72.7%	90.9%	90.9%	90.9%
Production Schedule (Pen-G equivalent)	130	208	260	260	260

Pen-G feedgrade	2.0	4.0	6.0	8.0	10.0
Pen-G human grade	7.0	15.0	22.0	30.0	39.0
6-APA	99.9	156.3	187.9	166.3	147.4
Bulk Ampicillin	6.0	8.4	9.6	12.0	12.0
Bulk Amoxycillin	13.1	20.2	28.6	35.7	41.7
Bulk Cloxacillin	1.1	2.1	3.2	4.2	5.3
Final Dosage Ampicillin	0.2	0.5	0.7	0.8	1.0
Final Dosage Amoxycillin	0.6	1.4	1.9	2.6	3.3
Final Dosage Cloxacillin	0.1	0.1	0.2	0.3	0.4

Option A			1995	1996	1997	1998	1999
FINANCIAL COSTS							
Initial Loans		Rate					
Foreign Currency Loans	938,786		938,786	751,029	563,272	375,515	187,758
Repayments	187,757	5.0	0	187,757	187,757	187,757	187,757
Interest		8.0	75,103	67,592	52,572	37,552	22,531
Local Currency Loans	45,824		0	45,824	30,549	15,274	0
Repayments	15,275	3.0		0	15,275	15,275	15,274
Interest		25.0		11,456	9,547	5,728	1,909
Additional Loans							
Cash Shortfall							
DEPRECIATION			147,400	147,400	147,400	147,400	147,399
Initial Investment							
Factory Site	20,350	0	0	0	0	0	0
Buildings and Civil Works	423,989	5	21,199	21,199	21,199	21,199	21,199
Auxiliary/Service Facilities	30,925	5	1,546	1,546	1,546	1,546	1,546
Production Equipment	231,629	5	11,581	11,581	11,581	11,581	11,581
Ancillary Prod. Equipment	188,363	5	9,418	9,418	9,418	9,418	9,418
Auxiliary Equipment	151,414	5	7,571	7,571	7,571	7,571	7,571
Vehicles	6,930	20	1,386	1,386	1,386	1,386	1,386
Service Equipment	12,870	10	1,287	1,287	1,287	1,287	1,287
Process/Technology Transfer	55,876	20	11,175	11,175	11,175	11,175	11,176
Pre-Production Expenditure	411,183	20	82,237	82,237	82,237	82,237	82,235
Replacement Investment							
Production Equipment	6,500	5	0	0	0	0	0
Vehicles - Year 2000	6,930	20	0	0	0	0	0
Vehicles - Year 2005	6,930	20	0	0	0	0	0
Service Equipment	12,870	10	0	0	0	0	0

Option A

		Year	1995	1996	1997	1998	1999
FACTORY COSTS Factor :	1.0						
Direct Production Staff	Salary	137	17,980				
Production Supervisors	180,000	15	2,700)				
Technicians	120,000	33	3,960)	Annual			
Skilled Workers	80,000	28	2,240)	Cost			
Unskilled Labour	40,000	32	1,280)				
Laboratory & Engineering Staff							
Supervisors	180,000	16	2,880)				
Technicians	120,000	17	2,040)	Annual			
Skilled Workers	80,000	26	2,080)	Cost			
Unskilled Labour	40,000	20	800)				
Factory Overheads							
Replacement Spare Parts	571,406	2	11,428	11,999	12,599	13,229	13,890
Repairs & Maintenance		3	4,679	7,639	9,764	10,435	11,029
Protective Clothing, etc			1,300	per annum			
OVERHEAD COSTS Factor :	1.0						
Management	Salary	44	5,050				
Chief Executive	800,000	1	800)				
Directors	500,000	2	1,000)	Annual			
Production/Lab/Engineering	250,000	5	1,250)	Cost			
Commercial/Administration	250,000	2	500)				
Administration/Other Personnel							
Accounts Officer	120,000	1	120)				
Storekeepers	60,000	4	240)				
Secretaries	60,000	4	240)				
Security Officers	60,000	2	120)	Annual			
Clerical Staff	40,000	8	320)	Cost			
Drivers	40,000	5	200)				
Receptionists	30,000	2	60)				
Watchmen	25,000	8	200)				
Administrative Overheads							
Insurance	1,046,120	1	10,461)				
Office Supplies			650)				
Communications			650)	Annual			
Land/Property Charges			156)	Cost			
Licences & Fees			130)				
Travel & Transport			400)				
Technology Transfer			1,950	1,950	1,950	1,950	1,950
Sundries			583	583	583	583	583

Option A		1995	1996	1997	1996	1999
SALES FORECAST Factor :	1.0					
Pen-G feedgrade		2.0	4.0	6.0	8.0	10.0
Pen-G human grade		7.0	15.0	22.0	30.0	39.0
6-APA		54.0	84.5	101.5	89.9	79.7
Bulk Ampicillin		5.0	7.0	8.0	10.0	10.0
Bulk Amoxycillin		11.0	17.0	24.0	30.0	35.0
Bulk Cloxacillin		1.0	2.0	3.0	4.0	5.0
Final Dosage Ampicillin		0.2	0.4	0.6	0.7	0.8
Final Dosage Amoxycillin		0.5	1.2	1.6	2.2	2.8
Final Dosage Cloxacillin		0.1	0.1	0.2	0.3	0.4
SALES REVENUES Factor :	1.00	155,965	254,620	325,475	347,818	367,628
Pen-G feedgrade	650	1,300	2,600	3,900	5,200	6,500
Pen-G human grade	1,300	9,100	19,500	28,600	39,000	50,700
6-APA	1,794	96,876	151,593	182,091	161,281	142,982
Bulk Ampicillin	2,002	10,010	14,014	16,016	20,020	20,020
Bulk Amoxycillin	2,340	25,740	39,780	56,160	70,200	81,900
Bulk Cloxacillin	2,860	2,860	5,720	8,580	11,440	14,300
Ampicillin Capsules	6,443	902	1,804	2,706	3,157	3,608
Ampicillin Syrups	14,726	884	1,767	2,651	3,092	3,534
Amoxycillin Capsules	11,466	4,013	9,631	12,842	17,658	22,473
Amoxycillin Syrups	18,720	2,808	6,739	8,986	12,355	15,725
Cloxacillin Capsules	10,500	735	735	1,470	2,205	2,940
Cloxacillin Syrups	24,554	737	737	1,473	2,210	2,946

SALES COSTS Factor :	1.0						
Manpower	Salary	44	6,285				

Sales Directors	500,000	2	1,000				
Sales Managers	250,000	2	500				
Salesman - Pen-G & 6-APA	180,000	1	180				
Sales Supervisors	180,000	3	540				
Sales Representatives	144,000	25	3,600				
Sales Administrator	120,000	1	120				
Senior Secretary	60,000	1	60				
Secretaries	35,000	4	140				
Clerical Staff	30,000	4	120				
Receptionist	25,000	1	25				
Other Sales/Distribution Costs							

Product Promotion - Fixed			1,385				
Travel & Transport			620				
Office Rental			750				
Product Promotion - Variable	5.0		504	1,071	1,506	2,034	2,561
Sales Commissions	2.5		252	535	753	1,017	1,281

UNIDO PENICILLIN PROJECT : OPTION A

KEY FINANCIAL RATIOS

Year	1	2	3	4	5
1. Simple Rate of Return					
- Total Investment	-12.8%	-12.1%	-11.6%	-10.8%	-10.0%
- Equity Capital	-41.7%	-41.3%	-37.7%	-33.0%	-28.3%
2. Break-Even Analysis					
- Sales Revenues		6,489,892	3,691,574	2,214,986	1,632,827
- Percentage of Sales		2548.9%	1134.2%	636.8%	444.2%
3. Debt:Equity Ratio					
- excluding Cash Shortfall	1.4	1.2	0.9	0.6	0.3
- including Cash Shortfall	1.6	1.8	2.0	2.1	2.2
4. Current Ratio	0.6	0.3	0.2	0.1	0.1
5. Debt Service Coverage Ratio	-1.8	-0.5	-0.4	-0.3	-0.2

BASE DATA ASSUMPTIONS : OPTION C

Option C		Year	1995	1996	1997	1998	1999
PENICILLIN FERMENTATION	batches		51	81	101	101	101
Fermentation Materials -	kg per batch						
Corn Steep Liquor	60,633		3092.3	4911.3	6123.9	6123.9	6123.9
Calcium Carbonate	15,157		773.0	1227.7	1530.9	1530.9	1530.9
Sodium Sulphate	9,549		487.0	773.5	964.4	964.4	964.4
Potassium Hydrogen Phosphate	909		46.4	73.6	91.8	91.8	91.8
Soy Bean Oil	4,729		241.2	383.0	477.6	477.6	477.6
Ammonium Sulphate	7,650		390.2	619.7	772.7	772.7	772.7
Ammonia Gas	940		47.9	76.1	94.9	94.9	94.9
Sulphuric Acid	1,440		73.4	116.6	145.4	145.4	145.4
Soy Bean Oil	1,260		64.3	102.1	127.3	127.3	127.3
Sucrose Solution	50,400		2570.4	4082.4	5090.4	5090.4	5090.4
Phenyl Acetic Acid Salt	9,900		504.9	801.9	999.9	999.9	999.9
Penicillin Extraction							
Butyl Acetate	5,530		282.0	447.9	558.5	558.5	558.5
Active Carbon	16.65		0.8	1.3	1.7	1.7	1.7
Sodium Bicarbonate	809		41.3	65.5	81.7	81.7	81.7
Butanol	2,390		121.9	193.6	241.4	241.4	241.4
Utilities -	Units per batch						
Steam - tons	120		6,120	9,720	12,120	12,120	12,120
Power - Mwh	279		14,227	22,595	28,174	28,174	28,174
Water - cu.metres	135		6,885	10,935	13,635	13,635	13,635

				1995	1996	1997	1998	1999
Fermentation Costs	Factor :	1.0	Total	67,879	107,802	134,423	134,423	134,423
			Local	43,382	68,901	85,913	85,913	85,913
Corn Steep Liquor		8,900		27,521	43,711	54,503	54,503	54,503
Calcium Carbonate		7,020 *		5,426	8,618	10,747	10,747	10,747
Sodium Sulphate		3,796 *		1,849	2,936	3,661	3,661	3,661
Potassium Hydrogen Phosphate		51,792 *		2,403	3,812	4,755	4,755	4,755
Soy Bean Oil		21,000		5,065	8,043	10,030	10,030	10,030
Ammonium Sulphate		683 *		267	423	528	528	528
Ammonia Gas		4,784 *		229	364	454	454	454
Sulphuric Acid		910 *		67	106	132	132	132
Soy Bean Oil		21,000		1,350	2,144	2,673	2,673	2,673
Sucrose Solution		3,675		9,446	15,003	18,707	18,707	18,707
Phenyl Acetic Acid Salt		28,236 *		14,256	22,642	28,233	28,233	28,233
Extraction Costs	Factor :	1.0		15,661	24,871	31,015	31,015	31,015
Butyl Acetate		39,000 *		10,998	17,468	21,782	21,782	21,782
Active Carbon		25,896 *		21	34	44	44	44
Sodium Bicarbonate		22,906 *		946	1,500	1,871	1,871	1,871
Butanol		30,316 *		3,696	5,869	7,318	7,318	7,318
Cost of Utilities	Factor :	1.0		35,277	56,029	69,862	69,862	69,862
Steam		600		3,672	5,832	7,272	7,272	7,272
Power		2,220		31,583	50,162	62,547	62,547	62,547
Water		3.17		22	35	43	43	43
Raw Material Cost per kg			Pesos	642.62	637.85	636.30	636.30	636.30
			US $	24.72	24.53	24.47	24.47	24.47

Option C			Year	1995	1996	1997	1998	1999
6-APA PRODUCTION	tonnes			65	102	125	120	114
Production Materials -	per tonne							
Pen-G				121.0	189.0	232.0	222.0	211.0
Amidase	0.005			0.33	0.51	0.63	0.60	0.57
Dichloromethane	6			390.0	612.0	750.0	720.0	684.0
Ammonia	1.5			97.5	153.0	187.5	180.0	171.0
Hydrochloric Acid 30%	2			130.0	204.0	250.0	240.0	228.0
Acetone	2.5			162.5	255.0	312.5	300.0	285.0
Production Costs Factor :	1.0			15,033	23,589	28,909	27,753	26,366
Pen-G	0			0	0	0	0	0
Amidase	0			0	0	0	0	0
Dichloromethane	23,530	*		9,177	14,400	17,648	16,942	16,095
Ammonia	4,940	*		482	756	926	889	845
Hydrochloric Acid 30%	2,340	*		304	477	585	562	534
Acetone	31,200	*		5,070	7,956	9,750	9,360	8,892
Cost of Utilities Factor :	1.0							
Steam/Power/Water	5,450			354	556	681	654	621
Raw Material Cost per kg			Pesos	1427.53	1413.17	1412.24	1408.43	1408.99
			US $	54.91				

Option C		Year	1995	1996	1997	1998	1999
BULK AMPICILLIN	tonnes		0.0	0.0	0.0	0.0	0.0
Production Materials -	kg per tonne						
6-APA	-		0.0	0.0	0.0	0.0	0.0
Acetone	680		0.0	0.0	0.0	0.0	0.0
Dichloromethane	960		0.0	0.0	0.0	0.0	0.0
Methyl Iso Butyl Ketone	400		0.0	0.0	0.0	0.0	0.0
Triethylamine	340		0.0	0.0	0.0	0.0	0.0
Ethylchlorocarbonate	372		0.0	0.0	0.0	0.0	0.0
Phenylglycine	491		0.0	0.0	0.0	0.0	0.0
Potassium Hydroxide	172		0.0	0.0	0.0	0.0	0.0
Ethanol	156		0.0	0.0	0.0	0.0	0.0
Ethylacetoacetate	440		0.0	0.0	0.0	0.0	0.0
Production Costs Factor :	1.0		0	0	0	0	0
6-APA	0		0	0	0	0	0
Acetone	31,200	*	0	0	0	0	0
Dichloromethane	23,530	*	0	0	0	0	0
Methyl Iso Butyl Ketone	40,560	*	0	0	0	0	0
Triethylamine	101,270	*	0	0	0	0	0
Ethylchlorocarbonate	452,400	*	0	0	0	0	0
Phenylglycine	665,600	*	0	0	0	0	0
Potassium Hydroxide	126,620	*	0	0	0	0	0
Ethanol	30,732	*	0	0	0	0	0
Ethylacetoacetate	85,020	*	0	0	0	0	0
Cost of Utilities Factor :	1.0						
Steam/Power/Water	81,500		0	0	0	0	0
Raw Material Cost per kg		Pesos	ERR	ERR	ERR	ERR	ERR
		US $	ERR				

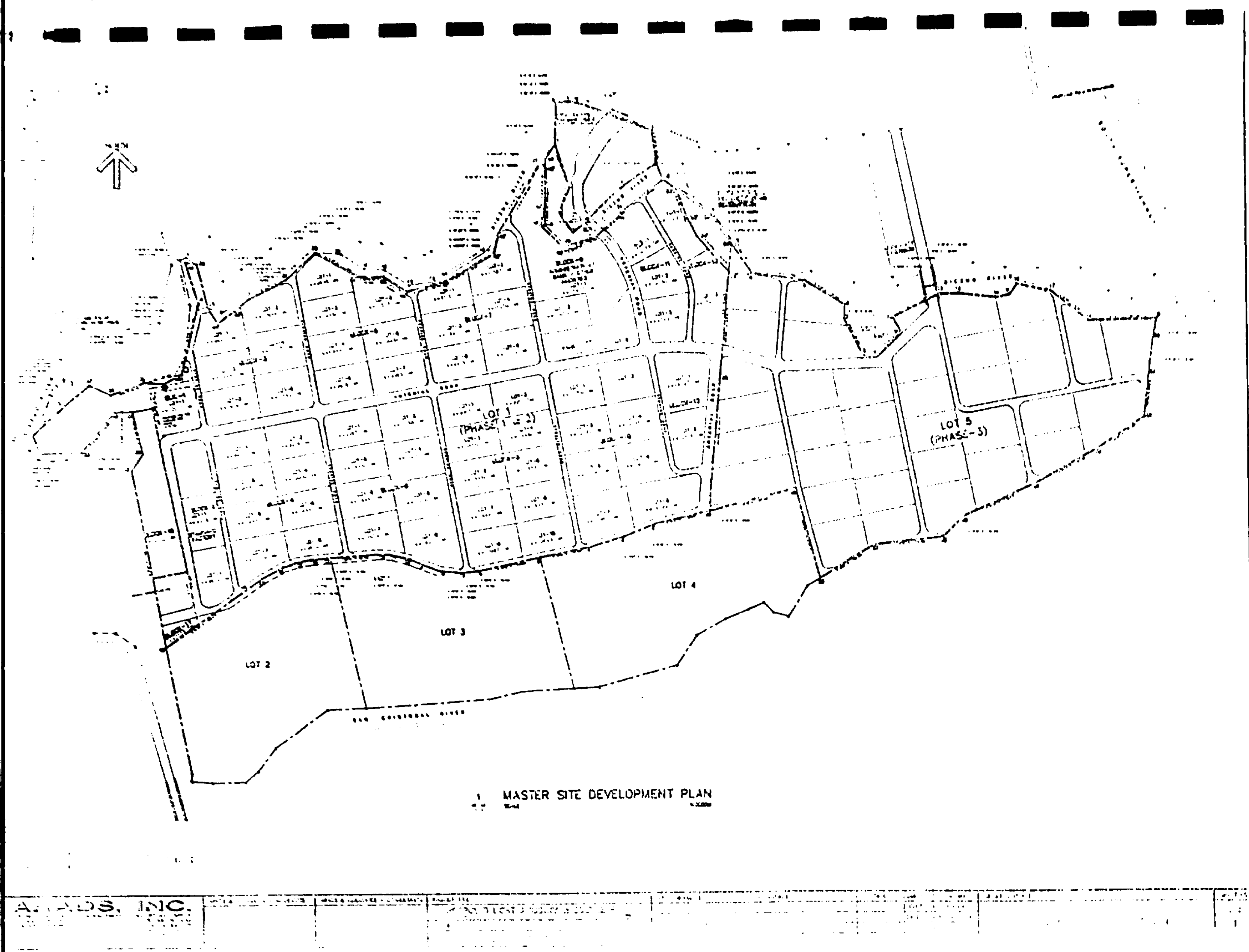
Option C		Year	1995	1996	1997	1998	1999
BULK AMOXYCILLIN	tonnes		0.0	0.0	0.0	0.0	0.0
Production Materials -	kg per tonne						
6-APA	-		0.0	0.0	0.0	0.0	0.0
Acetone	700		0.0	0.0	0.0	0.0	0.0
Dichloromethane	960		0.0	0.0	0.0	0.0	0.0
Methyl Iso Butyl Ketone	400		0.0	0.0	0.0	0.0	0.0
Triethylamine	330		0.0	0.0	0.0	0.0	0.0
Ethylchlorocarbonate	360		0.0	0.0	0.0	0.0	0.0
Phenylglycine	551		0.0	0.0	0.0	0.0	0.0
Potassium Hydroxide	183		0.0	0.0	0.0	0.0	0.0
Ethanol	166		0.0	0.0	0.0	0.0	0.0
Ethylacetoacetate	470		0.0	0.0	0.0	0.0	0.0
Production Costs Factor :	1.0		0	0	0	0	0
6-APA	0		0	0	0	0	0
Acetone	31,200	*	0	0	0	0	0
Dichloromethane	23,530	*	0	0	0	0	0
Methyl Iso Butyl Ketone	40,560	*	0	0	0	0	0
Triethylamine	101,270	*	0	0	0	0	0
Ethylchlorocarbonate	452,400	*	0	0	0	0	0
Phenylglycine	665,600	*	0	0	0	0	0
Potassium Hydroxide	126,620	*	0	0	0	0	0
Ethanol	30,732	*	0	0	0	0	0
Ethylacetoacetate	85,020	*	0	0	0	0	0
Cost of Utilities Factor :	1.0						
Steam/Power/Water	81,500		0	0	0	0	0
Raw Material Cost per kg		Pesos	ERR				
		US $	ERR				

Option C			Year	1995	1996	1997	1998	1999
BULK CLOXACILLIN	tonnes			0.0	0.0	0.0	0.0	0.0
Production Materials -	kg per tonne							
6-APA	-			0.0	0.0	0.0	0.0	0.0
Acetone	1,250			0.0	0.0	0.0	0.0	0.0
Methyl Iso Butyl Ketone	2,500			0.0	0.0	0.0	0.0	0.0
Acid Chloride	714			0.0	0.0	0.0	0.0	0.0
Sodium Hydroxide	116			0.0	0.0	0.0	0.0	0.0
Sodium Hexanoate	480			0.0	0.0	0.0	0.0	0.0
Production Costs Factor :	1.0			0	0	0	0	0
6-APA	0			0	0	0	0	0
Acetone	31,200	*		0	0	0	0	0
Methyl Iso Butyl Ketone	40,560	*		0	0	0	0	0
Acid Chloride	546,000	*		0	0	0	0	0
Sodium Hydroxide	251,160	*		0	0	0	0	0
Sodium Hexanoate	425,490	*		0	0	0	0	0
Cost of Utilities Factor :	1.0							
Steam/Power/Water	48,200			0	0	0	0	0
Raw Material Cost per kg			Pesos	ERR				
			US $	ERR				

Option C			Year	1995	1996	1997	1998	1999
FINAL DOSAGE FORMS	tonnes			0.0	0.0	0.0	0.0	0.0
Capsules - Percentage	70			0.0	0.0	0.0	0.0	0.0
Syrups - Percentage	30			0.0	0.0	0.0	0.0	0.0
Packaging Costs Factor :	1.0			0	0	0	0	0
Capsules	783,354	*		0	0	0	0	0
Syrups	1,456,000	*		0	0	0	0	0
Cost of Utilities Factor :	1.0							
Steam/Power/Water	350,000			0	0	0	0	0

APPENDIX 5-2

LOCATION MAP OF RECOMMENDED SITE



LOT 1
(PHASE 1 & 2)
LOT 5
(PHASE-3)
LOT 4
LOT 3
LOT 2
MASTER SITE DEVELOPMENT PLAN

APPENDIX 5-3 TYPICAL FACTORIES IN LAGUNA AREA - SOUTH MANILA

Option C			1995	1996	1997	1998	1999
FINANCIAL COSTS							
Initial Loans		Rate					
Foreign Currency Loans	831,773		831,773	665,418	499,063	332,708	166,353
Repayments	166,355	5.0	0	166,355	166,355	166,355	166,355
Interest		8.0	66,542	59,888	46,580	33,271	19,962
Local Currency Loans	37,118		0	37,118	24,745	12,372	0
Repayments	12,373	3.0		0	12,373	12,373	12,372
Interest		25.0		9,280	7,733	4,640	1,547
Additional Loans							
Cash Shortfall							
DEPRECIATION			130,672	130,672	130,672	130,672	130,671
Initial Investment							
Factory Site	20,350	0	0	0	0	0	0
Buildings and Civil Works	366,093	5	18,305	18,305	18,305	18,305	18,305
Auxiliary/Service Facilities	29,853	5	1,493	1,493	1,493	1,493	1,493
Production Equipment	190,031	5	9,502	9,502	9,502	9,502	9,502
Ancillary Prod. Equipment	167,532	5	8,377	8,377	8,377	8,377	8,377
Auxiliary Equipment	151,414	5	7,571	7,571	7,571	7,571	7,571
Vehicles	4,290	20	858	858	858	858	858
Service Equipment	12,155	10	1 216	1,216	1,216	1,216	1,216
Process/Technology Transfer	55,876	20	11,175	11,175	11,175	11,175	11,176
Pre-Production Expenditure	360,873	20	72,175	72,175	72,175	72,175	72,173
Replacement Investment							
Production Equipment	0	5	0	0	0	0	0
Vehicles - Year 2000	4,290	20	0	0	0	0	0
Vehicles - Year 2005	4,290	20	0	0	0	0	0
Service Equipment	12,155	10	0	0	0	0	0

Option C

		Year	1995	1996	1997	1998	1999
FACTORY COSTS	Factor : 1.0						
Direct Production Staff	Salary	140	13,640				
Production Supervisors	180,000	10	1,800)				
Technicians	120,000	19	2,280) Annual				
Skilled Workers	80,000	12	960) Cost				
Unskilled Labour	40,000	20	800)				
Laboratory & Engineering Staff							
Supervisors	180,000	16	2,880)				
Technicians	120,000	17	2,040) Annual				
Skilled Workers	80,000	26	2,080) Cost				
Unskilled Labour	40,000	20	800)				
Factory Overheads							
Replacement Spare Parts	508,977	2	10,180	10,689	11,223	11,784	12,373
Repairs & Maintenance		3	3,832	6,163	7,724	7,784	7,857
Protective Clothing, etc			1,300	per annum			
OVERHEAD COSTS	Factor : 1.0						
Management	Salary	42	4,550				
Chief Executive	800,000	1	800)				
Directors	500,000	2	1,000) Annual				
Production/Lab/Engineering	250,000	3	750) Cost				
Commercial/Administration	250,000	2	500)				
Administration/Other Personnel							
Accounts Officer	120,000	1	120)				
Storekeepers	60,000	4	240)				
Secretaries	60,000	4	240)				
Security Officers	60,000	2	120) Annual				
Clerical Staff	40,000	8	320) Cost				
Drivers	40,000	5	200)				
Receptionists	30,000	2	60)				
Watchmen	25,000	8	200)				
Administrative Overheads							
Insurance	921,368	1	9,214)				
Office Supplies			650)				
Communications			650) Annual				
Land/Property Charges			156) Cost				
Licences & Fees			130)				
Travel & Transport			400)				
Technology Transfer			1,950	1,950	1,950	1,950	1,950
Sundries			531	531	531	531	531

Appendix 12-13

UNIDO PENICILLIN PROJECT : OPTION C

KEY FINANCIAL RATIOS

in Pesos '000

Year	1	2	3	4	5
1. Simple Rate of Return					
- Total Investment	-13.1%	-13.1%	-13.1%	-12.9%	-12.7%
- Equity Capital	-42.5%	-43.5%	-41.4%	-38.2%	-34.9%
2. Break-Even Point					
- Sales Revenues		(2,733,655)	(3,460,830)	(4,610,841)	(7,545,324)
- Percentage of Sales		-1330.6%	-1344.2%	-1777.0%	-2881.0%
3. Debt:Equity Ratio					
- excluding Cash Shortfall	1.4	1.2	0.9	0.6	0.3
- including Cash Shortfall	1.6	1.9	2.1	2.2	2.4
4. Current Ratio	0.6	0.3	0.2	0.1	0.1
5. Debt Service Coverage Ratio	-1.8	-0.5	-0.5	-0.4	-0.4

Option C	1995	1996	1997	1998	1999
Maximum Possible Output (Pen-G)	286	286	286	286	286
Capacity Utilisation	45.5%	72.7%	90.9%	90.9%	90.9%
Production Schedule (Pen-G equivalent)	130	208	260	260	260

Pen-G feedgrade	2.0	4.0	6.0	8.0	10.0
Pen-G human grade	7.0	15.0	22.0	30.0	39.0
6-APA	121.0	189.0	232.0	222.0	211.0
Bulk Ampicillin	0.0	0.0	0.0	0.0	0.0
Bulk Amoxycillin	0.0	0.0	0.0	0.0	0.0
Bulk Cloxacillin	0.0	0.0	0.0	0.0	0.0
Final Dosage Ampicillin	0.0	0.0	0.0	0.0	0.0
Final Dosage Amoxycillin	0.0	0.0	0.0	0.0	0.0
Final Dosage Cloxacillin	0.0	0.0	0.0	0.0	0.0

Option C

SALES FORECAST	Factor : 1.0	1995	1996	1997	1998	1999
Pen-G feedgrade		2.0	4.0	6.0	8.0	10.0
Pen-G human grade		7.0	15.0	22.0	30.0	39.0
6-APA		65.4	102.2	125.4	120.0	114.1
Bulk Ampicillin		0.0	0.0	0.0	0.0	0.0
Bulk Amoxycillin		0.0	0.0	0.0	0.0	0.0
Bulk Cloxacillin		0.0	0.0	0.0	0.0	0.0
Final Dosage Ampicillin		0.0	0.0	0.0	0.0	0.0
Final Dosage Amoxycillin		0.0	0.0	0.0	0.0	0.0
Final Dosage Cloxacillin		0.0	0.0	0.0	0.0	0.0

SALES REVENUES Factor :	1.0	127,728	205,447	257,468	259,480	261,895
Pen-G feedgrade	650	1,300	2,600	3,900	5,200	6,500
Pen-G human grade	1,300	9,100	19,500	28,600	39,000	50,700
6-APA	1,794	117,328	183,347	224,968	215,280	204,695
Bulk Ampicillin	2,002	0	0	0	0	0
Bulk Amoxycillin	2,340	0	0	0	0	0
Bulk Cloxacillin	2,860	0	0	0	0	0
Ampicillin Capsules	6,443	0	0	0	0	0
Ampicillin Syrups	14,726	0	0	0	0	0
Amoxycillin Capsules	11,466	0	0	0	0	0
Amoxycillin Syrups	18,720	0	0	0	0	0
Cloxacillin Capsules	10,500	0	0	0	0	0
Cloxacillin Syrups	24,554	0	0	0	0	0

SALES COSTS Factor : 1.0

Manpower --------	Salary	2	680				
Sales Directors	500,000	1	500				
Sales Managers	250,000	0	0				
Salesman - Pen-G & 6-APA	180,000	1	180				
Sales Supervisors	180,000	0	0				
Sales Representatives	144,000	0	0				
Sales Administrator	120,000	0	0				
Senior Secretary	60,000	0	0				
Secretaries	35,000	0	0				
Clerical Staff	30,000	0	0				
Receptionist	25,000	0	0				
Other Sales/Distribution Costs ----------------------------							
Product Promotion - Fixed			555				
Travel & Transport			80				
Office Rental			0				
Product Promotion - Variable	5.0		0	0	0	0	0
Sales Commissions	2.5		0	0	0	0	0

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	489,444	467,275	482,344	499,757	[illegible]	514,515

[illegible]

[illegible] FINANCIAL [illegible]

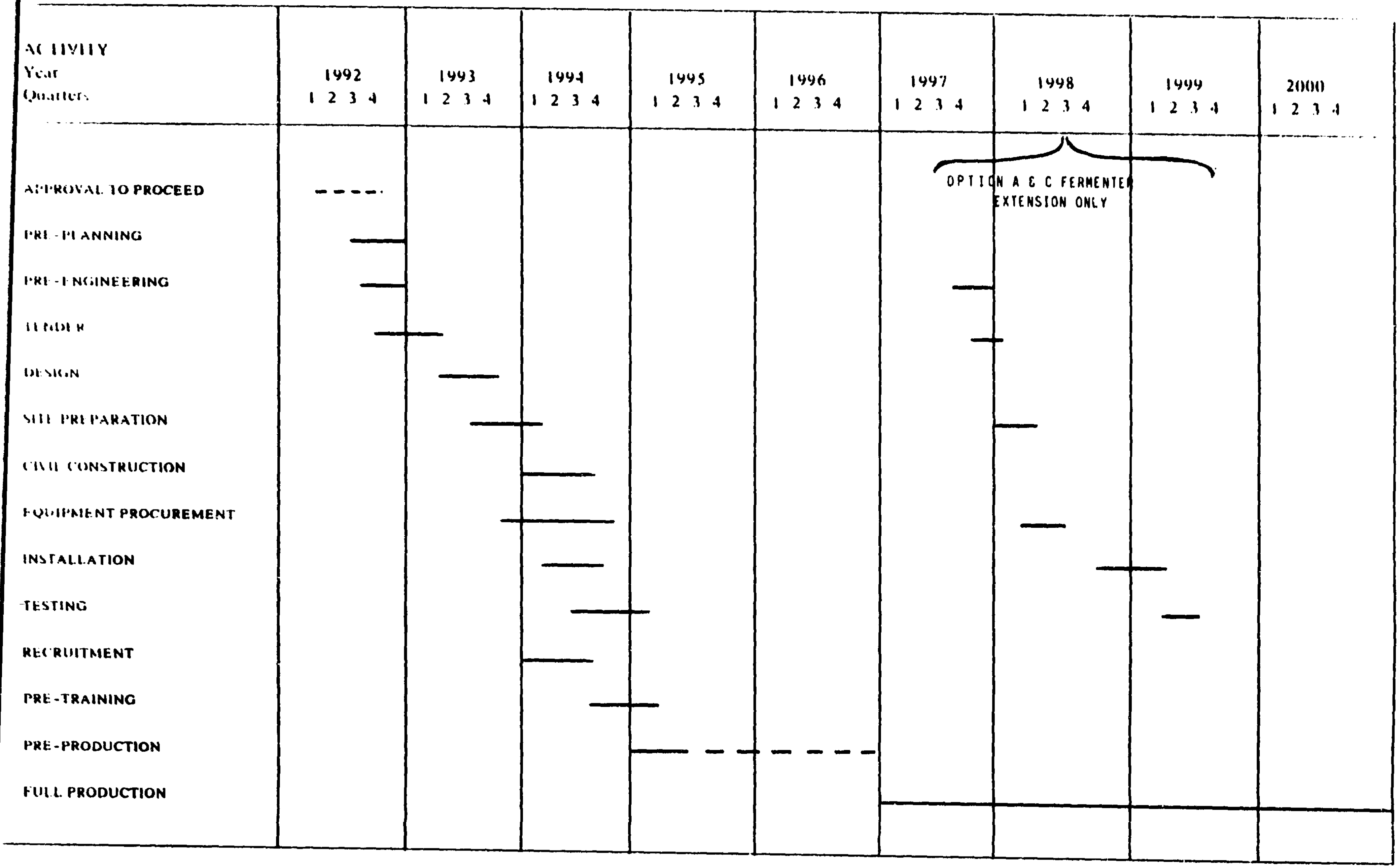
Simple Rate of Ret[illegible]	
[illegible]	[illegible]
Equity Cap[illegible]	[illegible]
Break-Even [illegible]	
Sales Revenue	[illegible]
Percentage [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2004	[illegible]	[illegible]	2007	2008	2009
FINANCIAL COSTS																	
Initial Loans		Rate															
Foreign Currency Loans	[illegible]		[illegible]	252,183	[illegible]	126,091	63,045					0	0			0	0
Repayments	63,046	[illegible]		63,046	63,046	63,046	63,046	63,045						0		0	
Interest		[illegible]	25,219	[illegible]	[illegible]	12,609	[illegible]	[illegible]						0		0	
Local Currency Loans	56,475			56,475	[illegible]	19,825											
Repayments	[illegible]				[illegible]	[illegible]	[illegible]							0		0	
Interest		[illegible]		14,119	11,765	[illegible]	[illegible]										
Additional Loans																	
Cash shortfalls																	
DEPRECIATION			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	14,977	[illegible]	14,977	[illegible]	14,977	14,977
Initial Investment																	
Factory Site	5,745												0		0		0
Buildings and Civil Works	49,251	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4,913	4,913	4,913	4,913	4,913	4,913
Auxiliary Service Facilities	3,59[illegible]		[illegible]	[illegible]	[illegible]	930	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	930	930	930	930	930
Production Equipment	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,593	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,593	2,593	2,593	2,593	2,593	2,593
Ancillary Prod. Equipment	[illegible]	[illegible]	[illegible]	[illegible]	2,165	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,165	2,165	2,165	2,165	2,165	2,165	2,165
Auxiliary Equipment	[illegible]	[illegible]	[illegible]	1,989	[illegible]	[illegible]	1,989	[illegible]	[illegible]	[illegible]	1,989	1,989	1,989	1,989	1,989	1,989	1,989
Vehicles	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,786	[illegible]						0		0	0	0
Service Equipment	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,001	1,001	1,001	1,001	1,001	1,001	1,001	0	0		0	0
Process Technology Transfer	[illegible]	[illegible]	[illegible]	171	171	171	[illegible]					0	0	0		0	0
Pre-Production Expenditure	[illegible]	[illegible]	[illegible]	45,020	45,020	45,020	[illegible]						0	0	0	0	0
Replacement Investment																	
Production Equipment	0	[illegible]										0	0	0	0	0	0
Vehicles - Year [illegible]	[illegible]							1,386	1,386	[illegible]	[illegible]	1,386	0	0	0	0	0
Vehicles - Year [illegible]	[illegible]					0						0	1,386	1,386	1,386	1,386	1,386
Service Equipment	[illegible]											0	1,001	1,001	1,001	1,001	1,001

Item	Salary	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2008	2009
FACTORY COSTS Factor [illegible]																		
Direct Production Staff	Salary		[illegible]															
Production Supervisors	[illegible]		[illegible]															
Technicians	[illegible]		[illegible]	Annual														
Skilled Workers	[illegible]	4	[illegible]	[illegible]														
Unskilled Labour	[illegible]	[illegible]	[illegible]															
Laboratory & Engineering Staff																		
Supervisors	[illegible]	5	1,440															
Technicians	125,000	[illegible]	1,440	Annual														
Skilled Workers	[illegible]	[illegible]	[illegible]	[illegible]														
Unskilled Labour	40,[illegible]	4	[illegible]															
Factory Overheads																		
Replacement Spare Parts	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4,107	4,396	4,616	4,847	5,089	[illegible]
Repairs & Maintenance		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	14,020	14,434	14,601	14,807	15,136
Protective Clothing, etc			[illegible]	per annum														
OVERHEAD COSTS Factor [illegible]																		
Management	[illegible]	4	[illegible]															
Chief Executive	[illegible]	[illegible]	[illegible]															
Directors	[illegible]	[illegible]	[illegible]	Annual														
Production and Engineering	[illegible]	[illegible]	[illegible]	[illegible]														
Commercial Administration	[illegible]		[illegible]															
Administration Other Personnel																		
Accounts Officer	[illegible]	1	[illegible]															
Storekeepers	[illegible]	4	[illegible]															
Secretaries	[illegible]	4	[illegible]															
Security Officers	[illegible]	[illegible]	[illegible]	Annual														
Clerical Staff	[illegible]		[illegible]	[illegible]														
Drivers	[illegible]		[illegible]															
Receptionists	[illegible]		[illegible]															
Watchmen	[illegible]	[illegible]	[illegible]															
Administrative Overheads																		
Insurance	[illegible]	[illegible]	[illegible]															
Office Supplies			[illegible]															
Communications			[illegible]	Annual														
[illegible]			[illegible]	[illegible]														
[illegible]			[illegible]															
Travel & Transport			[illegible]															
Technical Transfer			[illegible]															
Utilities			.92	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.92	.92	.92	.92	.92	.92	[illegible]

[illegible]	1995	1996	1997	1998	1999	[illegible]	[illegible]	[illegible]	2003	2004	2005	2006	2007	2008	2009
[illegible] output [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	141	141	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	164	169	169	169	169
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	44.5%	44.5%	44.5%	44.5%
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	249	249	249	249	249
[illegible]															
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	51.6
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	35.5	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.5	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

APPENDIX 9-1



PROJECT IMPLEMENTATION SCHEDULE (ALL OPTIONS)

PROJECT COST ESTIMATES **APPENDIX 9-2**

1.0 INTRODUCTION

This s a cost estimate for a penicillin plant to be constructed in the Philippines and considers the following options:-

OPTION 1	Based on a Filipino build cost representing processes covering Penicillin, 6APA, Dosage and Semi-synthetics.
OPTION 2	Based on a Filipino build cost representing processes covering 6APA, Dosage and Semi-synthetics.
OPTION 3	Based on a Filipino build cost representing processes covering Penicillin & 6APA.
ALTERNATIVE 1	Base case as OPTION 1 but based in a W European build.

All cost estimates include:

Major Equipment Procurement Costs,
Bulk Material, Procurement Costs,
Freight,
Construction, Labour & Indirects Costs,
Construction Sub-contracts,
Process Licenses,
Consultants & Studies,
Design Contractor Costs,
Construction Supervision Costs &
Commissioning Team Costs

The cost estimates have been prepared based on the preliminary engineering design, flowsheets, and quotations for the principal items of equipment.

The overall accuracy of the estimate is ± 15%

2.0 GENERAL

All costs contained herein are based in IQ92. No forward escalation beyond this datum is included.

3.0 BASE DATA

The following referenced technical data forms the basis of the estimate.

a) Flow sheets 1 to 10 (Appendix 6-1)
b) Plot layouts (Appendix 6-2)
c) Equipment lists (Appendix 6-3)
d) Equipment costs based on quotations received -

opening m/c	35,000	US$
ıa Sterilisation Plant	425,000	
menter	600,000	
ıtator for above	425,000	
& Steam Steriliser	306,000	
ed Fermenter	67,320	
ıtator for above	81,600	
ed Fermenter Air Steriliser	31,000	
lot Plant fermenter	500,000	
econdary Extractor	40,000	
enicilin Filter	102,000	
enicilin Dryer	85,000	
ich Butyl Acetate Carbon Filter	35,000	
enicilin G Feed Screw	6,000	
Batch Fluid Bed Dryer	90,000	
/acuum Filter	40,000	
Harvest Vessel	132,000	
Agitator for above	76,500	
Rotary Vacuum Filter	102,000	
Primary Extractor	150,000	
Metering Screw Feeder	30,000	
Dosage section	300,000	
Compressors (utility)	1,188,600	
TOTAL	4,848,020	US$

ve costs are reduced by 30% for the Filipino build options
ıg local (Asia Basin) area procurement, therefore giving a
S$3,393,600.

ST ESTIMATE SUMMARIES

owing lists the cost estimate summaries for the various options.

	FILIPINO BUILD OPTION 1 MILL US$	FILIPINO BUILD OPTION 2 MILL US$	FILIPINO BUILD OPTION 3 MILL US$	W.EUROPE BUILD OPTION 1 MILL US$
ıpment Procure	12.1	2.8	10.7	16.1
Material Procure	6.0	1.4	5.3	8.0
struction	15.2	3.8	13.7	26.1
-contracts	incl.	incl.	incl.	incl.
ıor Support Contracts	1.5	0.6	1.5	1.5
ıior Support Contracts	12.6	6.6	10.9	10.4
	47.4	15.2	42.1	62.1

ırther details can be found in Section 7.0.

5.0 BASIS OF COSTS ESTIMATES

Equipment Procurement Costs.

In addition to the requirements listed on the provided equipment lists, provided flowsheets have been referenced to identify other items of equipment not "tagged" on the equipment lists. These mainly consist of minor pumps, filters & vessels etc. Further details can be found in Section 7.0.

Also in addition to the identified items from equipment lists & flowsheets allowances are included to cover for miscellaneous hoists & gantries, a weighbridge is also included within the Media Preparation section on the assumptiopn that documentary proof is required of raw material deliveries.

Where item costs for equipment are not provided, costs are based on a) factored from those provided, or, b) based on in house data, or, c) estimted.

Bulk Material Procurement Costs.

Covered here are piping, electrical, instrumentation & commissioning spares. Instrumentation is assumed to include telecommunications.

As the majority of equipment is designated as stainless steel, then consequently, all piping is assumed to be of similar high grade material.

Also, as this is a pharmacutical plant & purity is of the utmost importance it is assumed that instrumentation & controls will suitably be to very high specifications.

No special electrical requiremnts are assumed although this account cannot be accurately forecast until the power generation & distribution philosophies are established.

Commissioning spares are included to allow for consumables during the initial pre & system commissioning phases. No allowances are included for insurance or operating spares.

Cost estimates are based on in house data factors specifically relating to an anti–biotics plant under construction in the UK.

Construction and Sub–contracts.

Covered here are direct construction labour costs for equipment, piping, electrical, instrumentation and steelwork erection. Steelwork is assumed a supply & erect contract.

Sub–contracts are included for insulation, painting, fire & gas, cotrol system, scaffolding & pre–commissioning.

All the above are based on in house data factors.

An allowance is included for crane hire over & above the requirements which will form part of the installation contractors statutory contracual obligations.

Costs are included for site establishment, general civils & piling sub-contracts. These cannot be accurately or sensibly forecast until such a time that actual site conditions & locations are established.

Minor Support Contracts.

Allowances are included here to cover for vendor representatives during construction, process licenses (if required), engineering support during construction, consultants & studies. Most projects attract these costs in one form or another, the exact scope must be established before these can be accurately forecast.

Major Support Contracts.

Costs are included here for conceptual design, detail design contractor, construction supervision, commissioning team & commissioning trades to assist the commissioning team.

Manhours are first estimated to which a contract rate is applied to realise total costs. Manhours are based on in house data from projects of similar nature. These may vary when all cotractual philosophies are established.

For instance, if all design is to be awarded to a single design contractor without competative bidding, conceptual engineering may be greatly reduced or eliminated due to the combining of work scopes & non requirement of familirisation.

6.0 EXCLUSIONS

The following must be considered excluded from all cost estimates contained herein.

- LAND & RIGHTS OF WAY
- PLANNING APPLICATION COSTS
- SEISMIC & SITE SURVEYS (including bore holes and soil sampling)
- ESCALATION
- CONTINGENCIES (although an indicative % is shown in Section 7.0)
- ALL CLIENT COSTS & EXPENSES
- OPERATOR TRAINING & MANUALS
- POWER GENERATION
- INSURANCES, BONDS & WARRANTIES
- LOCAL AGENT FEES & DISPURSEMENTS
- BONDED STORES and/or WAREHOUSING
- PRESERVATION DURING STORAGE
- TAXES, DUTIES & DUES
- CONSTRUCTION CAMP COSTS
- ANY EXTENTION TO LOCAL INFRASTRUCTURE
- TIE-INS TO EXISTING FACILITIES (if reqd)
- MANAGEMENT CONTRACTOR COSTS
- LOCAL OFFICE ESTABLISMENT
- RIOTS & WARS
- STRIKES & MAJOR DISRUPTIONS

7.0 COST ESTIMATE DETAILS

The proceeding pages show the detail estimate sheets for all study options.

As an indication, it is recommended to add a 10% contingency to the figures shown.

UNIDO PENICILLIN PROJECT : OPTION A

Appendix 10-1

INITIAL FIXED INVESTMENT COSTS

in Pesos '000

	Foreign Currency	Local Currency	Total Cost
1. Land			
Land Purchase	0	12,000	12,000
10% Contingency Allowance	0	1,200	1,200
	0	13,200	13,200
2. Site Preparation/Development			
Site Establishment & Development	0	6,500	6,500
10% Contingency Allowance	0	650	650
	0	7,150	7,150
3.1 Buildings & Civil Works			
Civils, Piling, Scaffolding, etc	0	45,669	45,669
Buildings - Fermentation etc	0	42,575	42,575
Buildings - 6-APA	0	13,000	13,000
Buildings - Semi-Synthetics	0	19,500	19,500
Mechanical, Piping, Steel Supply	116,927	11,693	128,620
E&I Installation	60,692	6,069	66,761
Insulation, Painting	0	11,814	11,814
Control System	0	53,362	53,362
Pre-Commissioning	4,144	0	4,144
10% Contingency Allowance	18,176	20,368	38,544
	199,939	224,050	423,989
3.2 Auxiliary & Service Facilities			
Transformer Sub-Station	0	814	814
Compressor House	0	3,250	3,250
Laboratory, Offices, Warehouse	0	16,250	16,250
Administration Block	0	7,800	7,800
10% Contingency Allowance	0	2,811	2,811
	0	30,925	30,925
4. Incorporated Fixed Assets			
Process Licences	14,396	0	14,396
Technology Transfer	36,400	0	36,400
10% Contingency Allowance	5,080	0	5,080
	55,876	0	55,876

		Foreign Currency	Local Currency	Total Cost
5.1	Production Machinery & Equipment			
	Media Preparation	19,525	1,953	21,478
	Additive Preparation	7,367	737	8,104
	Penicillin Fermentation	67,502	6,750	74,252
	Downstream Recovery	17,170	1,717	18,887
	Penicillin Purification	24,617	2,462	27,079
	6-APA Plant	7,781	778	8,559
	Semi-Synthetics Production	20,575	2,058	22,633
	Dosage Section	10,938	1,094	12,032
	Packing, Insurance & Shipping	17,548	0	17,548
	10% Contingency Allowance	19,302	1,755	21,057
		212,325	19,304	231,629
5.2	Ancillary Production Equipment			
	Piping	42,747	4,275	47,022
	Electrical	28,499	2,850	31,349
	Instrumentation	71,245	7,125	[illegible]3,370
	Commissioning Spares	6,412	641	7,053
	Packing, Insurance & Shipping	7,445	0	7,445
	10% Contingency Allowance	15,635	1,489	17,124
		171,983	16,380	188,363
5.3	Auxiliary Equipment			
	Utilities	107,687	10,769	118,456
	Mechanical Handling	1,820	182	2,002
	Workshop Equipment	3,900	390	4,290
	Laboratory Equipment	1,300	130	1,430
	Packing, Insurance & Shipping	11,471	0	11,471
	10% Contingency Allowance	12,618	1,147	13,765
		138,796	12,618	151,414
5.4	Vehicles			
	Company Cars - Senior Management	0	1,600	1,600
	Company Cars - Sales & Distribution	0	2,800	2,800
	Lorry, Pick-up Truck, Fork-Lift	0	1,900	1,900
	10% Contingency Allowance	0	630	630
		0	6,930	6,930
5.5	Service Equipment			
	Office Equipment & Furniture	0	7,800	7,800
	Canteen & Medical Facilities	0	3,900	3,900
	10% Contingency Allowance	0	1,170	1,170
		0	12,870	12,870
	Total	778,919	343,427	1,122,346

APPENDIX 10-1

INITIAL FIXED INVESTMENT COSTS : OPTION A

1. Land

1.1 It has been assumed that the project would be located in the Light Industry and Science Park in the Calabar region. The cost of a suitable site measuring 10,000 sq.m. in total has been based on an average price of P 1,200 per sq.m., as per information obtained in the Philippines.

1.2 Provision has been made for a contingency allowance of 10%, calculated by reference to the purchase price of the land.

2. Site Preparation and Development

2.1 The price quoted of P 6.5 million should cover all initial site preparation and subsequent development work, including landscaping, internal roadways and parking areas, security fencing and gatehouse, connections to mains electricity and water, etc.

2.2 Provision has been made for a contingency allowance of 10%, calculated by reference to the total cost estimate.

3. Buildings and Civil Works

3.1 The prices quoted are in accordance with the detailed cost estimates presented at Appendix 9-2, converted into Pesos.

3.2 Further provision has been made for payment of 10% customs duties on all imported items (mechanical erection, piping, steel supply, fire/gas supply, electrics and instrumentation installation), and for an overall 10% contingency allowance.

4. Incorporated Fixed Assets

4.1 The cost of process licensing has been estimated at 10% of the process equipment, as per the detailed cost estimates presented at Appendix 9-2. The additional cost of initial technology transfer in respect of penicillin production has also been included, broken down as follows :

Hindustan Antibiotics Ltd	:	US$ 0.9 million
Panlabs Incorporated	:	US$ 0.5 million

4.2 Provision has been made for a contingency allowance of 10%, calculated by reference to the total cost estimate.

5. **Production/Auxiliary Machinery and Equipment**

5.1 The prices quoted are in accordance with the detailed cost estimates presented at Appendix 9-2, converted into Pesos.

5.2 Further provision has been made for payment of 10% customs duties on all imported items, and for an overall contingency allowance of 10%.

6. **Vehicles**

6.1 It has been assumed that the project would require the following vehicles, all of which could be purchased from local suppliers :

4 x Company Cars - Senior Management
7 x Company Cars - Sales and Distribution Staff
1 x 3-tonne Lorry
1 x Pick-up Truck or Van
1 x Fork-lift Truck

6.2 The prices quoted have been based on information obtained in the Philippines. Separate provision has been made for a contingency allowance of 10%, calculated by reference to the total cost estimate.

7. **Service Equipment**

7.1 It has been assumed that all office equipment and furniture would be purchased from local suppliers, as would canteen and medical facilities for the project staff. The cost of these items has been estimated by reference to the nature of the project and the number of employees.

7.2 Separate provision has been made for a contingency allowance of 10%, calculated by reference to the total cost estimate.

UNIDO PENICILLIN PROJECT : OPTION A

Appendix 10-2

INITIAL FIXED INVESTMENT COST SCHEDULE

in Pesos '000

Year	1993	1994	1995
1. Land			
- Foreign Currency	0	0	0
- Local Currency	13,200	0	0
- Total	13,200	0	0
2. Site Preparation/Development			
- Foreign Currency	0	0	0
- Local Currency	7,150	0	0
- Total	7,150	0	0
3. Structures & Civil Works			
- Foreign Currency	39,988	159,951	0
- Local Currency	50,995	203,980	0
- Total	90,983	363,931	0
4. Incorporated Fixed Assets			
- Foreign Currency	0	27,938	27,938
- Local Currency	0	0	0
- Total	0	27,938	27,938
5. Plant, Machinery & Equipment			
- Foreign Currency	58,004	428,329	36,771
- Local Currency	5,311	59,411	3,380
- Total	63,315	487,740	40,151
6. Total Initial Investment Costs			
- Foreign Currency	97,992	616,218	64,709
- Local Currency	76,656	263,391	3,380
Total	174,648	879,609	68,089

APPENDIX 10-2

INITIAL FIXED INVESTMENT COST SCHEDULE : OPTION A

1. Land and Site Development

1.1 It has been assumed that the entire cost of purchasing and developing the project site would be incurred in 1993, this being the first year of project implementation.

2. Structures and Civil Works

2.1 It has been assumed that 20% of the cost of the structures and civil works would be incurred in 1993, and the balance of 80% upon completion of this work in 1994.

3. Incorporated Fixed Assets

3.1 It has been assumed that 50% of the combined cost of the process licences and technology transfer would be incurred in 1994, and the balance of 50% upon the commencement of operations in 1995.

4. Production Machinery and Equipment

4.1 It has been assumed that the suppliers of the production machinery and equipment would require a 20% downpayment in 1993, and that a further 70% of the total purchase price would be payable in 1994. Provision has therefore been made for retention of the balance of 10% until the commencement of operations in 1995, by way of performance guarantee.

5. Ancillary and Auxiliary Equipment

5.1 It has been assumed that the suppliers of the ancillary production equipment and of the auxiliary equipment would also require a 5% downpayment in 1993, and that a further 90% of the total purchase price would be payable in 1994. Provision has again been made for retention of the balance of 5% until 1995, by way of performance guarantee.

6. Vehicles and Service Equipment

6.1 It has been assumed that the entire cost of purchasing the vehicles, office equipment/furniture and canteen/medical facilities required would be incurred in the final phase of project implementation in 1994, immediately prior to the start-up of operations.

UNIDO PENICILLIN PROJECT : OPTION A

Appendix 10-3

PRE-PRODUCTION EXPENDITURE SCHEDULE

in Pesos '000

Year	1993	1994	1995
1. Pre-Investment Studies			
- Foreign Currency	8,580	0	0
2. Preparatory Engineering Studies			
- Foreign Currency	24,539	0	0
3. Management of Project Implementation			
- Foreign Currency	2,808	11,232	0
4. Detailed Engineering/Tendering			
- Foreign Currency	135,907	90,605	0
5. Supervision, Testing and Commissioning			
- Foreign Currency	14,359	57,437	0
- Local Currency	1,767	7,068	0
- Total	16,126	64,505	0
6. Recruitment and Staff Training			
- Foreign Currency	0	7,800	0
- Local Currency	0	1,300	0
- Total	0	9,100	0
7. Arrangements for Supplies			
- Local Currency	0	520	0
8. Arrangements for Marketing			
- Local Currency	0	2,080	0
9. Build-up of Connections			
- Local Currency	520	780	0
10. Capital Issue Expenditure			
- Local Currency	1,300	5,200	0
11. 10% Contingency Allowance			
- Foreign Currency	18,619	16,708	0
- Local Currency	359	1,695	0
- Total	18,978	18,403	0
12. Total Pre-Production Expenditure			
- Foreign Currency	204,812	183,782	0
- Local Currency	3,946	18,643	0
Total	208,758	202,425	0

APPENDIX 10-3

PRE-PRODUCTION EXPENDITURE SCHEDULE : OPTION A

1. Pre-Investment and Preparatory Engineering Studies

1.1 It has been assumed that the entire cost of pre-investment and preliminary engineering studies would be incurred in the earliest phase of project implementation in 1993.

2. Management of Project Implementation

2.1 It has been assumed that 20% of the cost of the management team in charge of project implementation would be incurred during 1993, and the balance of 80% during 1994.

3. Detailed Engineering and Tendering

3.1 It has been assumed that 60% of the cost of the detailed engineering work to be undertaken would be incurred during 1993, and the balance of 40% during 1984.

4. Supervision, Testing and Commissioning

4.1 It has been assumed that 20% of the total combined cost of supervising the buildings and civil works, and testing and commissioning the plant and equipment, would be incurred during 1993, and the balance of 80% during 1994.

5. Recruitment and Staff Training

5.1 It has been assumed that the entire cost of recruiting staff and sending them for advance training overseas would be incurred in 1994, immediately prior to the commencement of operations.

6. Arrangements for Supplies and Marketing

6.1 It has been assumed that all preliminary expenditure in respect of arrangements for supplies and marketing would be incurred in 1994, prior to the start-up of operations.

7. Build-up of Connections and Capital Issue Expenditure

7.1 It has been assumed that 40% of the cost of project and other approvals and 20% of the cost of legal and other fees related to the registration and financing of the project would be incurred in 1993, with the respective balances of 60% and 80% falling due in 1994.

UNIDO PENICILLIN PROJECT : OPTION A

Appendix 10-4

WORKING CAPITAL REQUIREMENTS

in Pesos '000

		Minimum Coverage	Turnover Coefficient	1995	1996	1997	1998	1999
1.	Current Assets							
	a) Accounts Receivable	30	12	17,837	25,493	30,811	31,614	32,192
	b) Inventory							
	- Local Materials	10	36	1,205	1,914	2,386	2,386	2,386
	- Imported Materials	120	3	22,707	36,019	45,509	47,684	49,058
	- Spare Parts	180	2	5,714	6,000	6,300	6,615	6,945
	- Work-in-Progress	30	12	15,351	22,937	28,201	28,937	29,449
	- Finished Products	30	12	17,020	24,606	29,870	30,606	31,118
	c) Cash in Hand	15	24	5,847	6,193	5,629	4,931	4,231
	Total Current Assets			85,681	123,162	148,706	152,773	155,379
2.	Current Liabilities							
	a) Accounts Payable	30	12	12,402	19,[illegible]94	24,730	25,359	25,766
3.	Working Capital							
	a) Net Working Capital			73,279	103,468	123,976	127,414	129,613
	b) Increase in Working Capital			73,279	30,189	20,508	3,438	2,199
4.	Total Production Costs			436,543	532,368	579,254	570,048	558,142
	less : Raw Materials			111,502	176,959	222,439	228,964	2[illegible]3,088
	: Utilities			37,325	59,367	74,324	75,339	76,104
	: Depreciation			147,400	147,400	147,400	147,400	147,399
				140,316	148,642	135,091	118,345	101,551
5.	Required Cash Balance	15	24	5,847	6,193	5,629	4,931	4,231

Accounts Receivable : 30 days x operating costs (production costs minus depreciation and interests)
Work-in-Progress : 30 days x factory costs
Finished Products : 30 days x factory costs plus administrative overheads
Cash in Hand : 15 days x production costs (less raw materials, utilities and depreciation)
Accounts Payable : 30 days x raw materials and utilities

UNIDO PENICILLIN PROJECT : OPTION A

Appendix 10-4

CALCULATION OF WORKING CAPITAL

in Pesos '000

Year		1995	1996	1997	1998	1999
	Raw Materials					
	- Local Materials	43,382	68,901	85,913	85,913	85,913
	- Imported Materials	68,120	108,058	136,526	143,051	147,175
	Direct Labour	10,180	10,180	10,180	10,180	10,180
	Utilities	37,325	59,367	74,324	75,339	76,104
	Replacement Spare Parts	11,428	11,999	12,599	13,229	13,890
	Repairs & Maintenance	4,679	7,639	9,764	10,435	11,029
	Factory Overhead Costs	9,100	9,100	9,100	9,100	9,100
1.	Total Factory Costs	184,214	275,244	338,406	347,247	353,391
	Administrative Overheads	20,030	20,030	20,030	20,030	20,030
	Sales & Distribution Costs	9,796	10,646	11,299	12,091	12,882
2.	Operating Costs	214,040	305,920	369,735	379,368	386,303
	Financial Costs	75,103	79,048	62,119	43,280	24,440
	Depreciation	147,400	147,400	147,400	147,400	147,399
3.	Total Production Costs	436,543	532,368	579,254	570,048	558,142

APPENDIX 10-4

CALCULATION OF WORKING CAPITAL : OPTION A

1. Calculation of Working Capital Requirement

1.1 The provisions made in respect of total current assets and current liabilities have been calculated by reference to the following minimum requirements :

Accounts Receivable	:	30 days x operating costs
Inventory		
- Local Materials	:	10 days x cost of materials
- Imported Materials	:	120 days x cost of materials
- Spare Parts	:	180 days x cost of spare parts
- Work-in-Progress	:	30 days x factory costs
- Finished Products	:	30 days x factory costs plus administrative overheads
Cash in Hand	:	15 days x production costs less raw materials, utilities and depreciation
Accounts Payable	:	30 days x cost of raw materials plus utilities

1.2 The difference between total current assets and current liabilities represents the net working capital requirement in each year.

1.3 The total initial investment costs of the project include provision for the net working capital requirement in 1997, given that the plant would then be operating at its maximum of 91% capacity utilisation.

2. Total Production Costs

2.1 The figures quoted in respect of total factory costs, administrative overheads, sales and distribution costs, financial costs and depreciation have been taken directly from the detailed production cost schedule presented at Appendix 10-8b.

UNIDO PENICILLIN PROJECT : OPTION A

Appendix 10-5

TOTAL INVESTMENT COST SCHEDULE : 1993 - 1999

in Pesos '000

Year	1993	1994	1995	1996	1997	1998	1999
1. Initial Investment Costs							
- Foreign Currency	97,992	616,218	64,709	0	0	0	0
- Local Currency	76,656	263,391	3,380	0	0	0	0
- Total	174,648	879,609	68,089	0	0	0	0
Replacement Investment							
- Foreign Currency	0	0	0	0	0	0	0
- Local Currency	0	0	0	0	0	0	0
- Total	0	0	0	0	0	0	0
2. Preproduction Expenditure							
- Foreign Currency	204,812	183,782	0	0	0	0	0
- Local Currency	3,946	18,643	0	0	0	0	0
- Total	208,758	202,425	0	0	0	0	0
3. Working Capital Increase	0	0	73,279	30,189	20,508	3,438	2,199
Total Investment Costs	383,406	1,082,034	141,368	30,189	20,508	3,438	2,199

APPENDIX 10-5

TOTAL INVESTMENT COST SCHEDULE : OPTION A

1. Initial and Replacement Investment Costs

1.1 The figures quoted in respect of initial investment costs have been taken directly from the cost schedule presented at Appendix 10-2.

1.2 It has been assumed that there would be no replacement investment during the period to 1999.

2. Pre-Production Expenditure

2.1 The figures quoted in respect of pre-production capital expenditure have been taken directly from the expenditure schedule presented at Appendix 10-3.

3. Working Capital Increase

3.1 The figures quoted in respect of the increase in the net working capital requirement in each year have been taken directly from the working capital schedule presented at Appendix 10-4.

UNIDO PENICILLIN PROJECT : OPTION A

Appendix 10-6

TOTAL ASSETS SCHEDULE : 1993 - 1999

in Pesos '000

Year		1993	1994	1995	1996	1997	1998	1999
1.	Initial Investment Costs							
	- Foreign Currency	97,992	616,218	64,709	0	0	0	0
	- Local Currency	76,656	263,391	3,380	0	0	0	0
	- Total	174,648	879,609	68,089	0	0	0	0
	Replacement Investment							
	- Foreign Currency	0	0	0	0	0	0	0
	- Local Currency	0	0	0	0	0	0	0
	- Total	0	0	0	0	0	0	0
2.	Preproduction Expenditure							
	- Foreign Currency	204,812	183,782	0	0	0	0	0
	- Local Currency	3,946	18,643	0	0	0	0	0
	- Total	208,758	202,425	0	0	0	0	0
3.	Current Assets Increase	0	0	85,681	37,481	25,544	4,067	2,606
	Total Assets	383,406	1,082,034	153,770	37,481	25,544	4,067	2,606

APPENDIX 10-6

TOTAL ASSETS SCHEDULE : OPTION A

1. Initial and Replacement Investment Costs

1.1 The figures quoted in respect of initial investment costs have been taken directly from the cost schedule presented at Appendix 10-2.

1.2 It has been assumed that there would be no replacement investment during the period to 1999.

2. Pre-Production Expenditure

2.1 The figures quoted in respect of pre-production capital expenditure have been taken directly from the expenditure schedule presented at Appendix 10-3.

3. Current Assets Increase

3.1 The figures quoted in respect of the increase in current assets in each year have been calculated by reference to the working capital schedule detailed in Appendix 10-4.

3.2 The total initial assets of the project include provision for the total current assets figure in 1997, given that the plant would then be operating at its maximum of 91% capacity utilisation.

UNIDO PENICILLIN PROJECT : OPTION A

Appendix 10-7

INITIAL FINANCING PLAN

in Pesos '000

Year	1993	1994	1995	1996	1997	1998	1999
1. Equity Subscription							
- Promoters	403,736	0	0	0	0	0	0
- Financial Institutions	269,158	0	0	0	0	0	0
2. Foreign Currency Loans	33,646	800,000	105,140	0	0	0	0
3. Local Currency Loans	0	0	0	45,824	0	0	0
4. Current Liabilities	0	0	12,402	7,292	5,036	629	407
Total	706,540	800,000	117,542	53,116	5,036	629	407

APPENDIX 10-7

INITIAL FINANCING PLAN : OPTION A

1. Equity Subscription

1.1 It has been assumed that both the local promoters and those financial institutions invited to participate in the project would subscribe for their shares in full during 1993, and would therefore take up their respective shareholdings of 60% and 40% at the outset.

1.2 It may be noted that this would ensure that the project had sufficient funds in hand to cover anticipated expenditure on local investment items, including working capital, during the implementation phase and the first year of operations.

2. Foreign Currency Loans

2.1 It has been assumed that the foreign currency loans would be drawndown in three tranches as follows :

1993	:	P 33,646,000	=	3.6%
1994	:	P 800,000,000	=	85.2%
1995	:	P 105,141,000	=	11.2%
		P 938,787,000		

2.2 It may be noted that this would ensure that the project had sufficient funds in hand to cover anticipated expenditure on imported investment items, including working capital, during both the implementation phase and the 3-year build-up to full capacity utilisation in 1997.

3. Local Currency Loans

3.1 It has been assumed that the local currency loans would be drawndown in their entirety in 1996, and would therefore be used to fund the balance of the working capital requirement of the project.

4. Current Liabilities

4.1 The figures quoted in respect of the increase in current liabilities in each year have been calculated by reference to the working capital schedule detailed in Appendix 10-4.

UNIDO PENICILLIN PROJECT : OPTION A

Appendix 10-8a

PRODUCTION COST SCHEDULE

in Pesos '000

Year	1995	1996	1997	1998	1999
1. Direct Materials & Inputs	148,827	236,326	296,763	304,303	309,192
2. Direct Manpower	10,180	10,180	10,180	10,180	10,180
3. Factory Overheads	25,207	28,738	31,463	32,764	34,019
Factory Costs	184,214	275,244	338,406	347,247	353,391
4. Administrative Overheads	20,030	20,030	20,030	20,030	20,030
5. Sales & Distribution Costs	9,796	10,646	11,299	12,091	12,882
Operating Costs	214,040	305,920	369,735	379,368	386,303
6. Financial Costs	75,103	79,048	62,119	43,280	24,440
7. Depreciation	147,400	147,400	147,400	147,400	147,399
Total Production Cost	436,543	532,368	579,254	570,048	558,142

UNIDO PENICILLIN PROJECT : OPTION A — Appendix 10-8b

DETAILED PRODUCTION COST SCHEDULE — in Pesos '000

Year		1995	1996	1997	1998	1999
1.1 Direct Materials						
Fermentation Materials	- Imported	24,497	38,901	48,510	48,510	48,510
	- Local	43,382	68,901	85,913	85,913	85,913
Extraction Materials	- Imported	15,661	24,871	31,015	31,015	31,015
6-APA Production	- Imported	15,033	23,589	28,909	27,753	26,366
Bulk Ampicillin	- Imported	3,420	4,844	5,605	7,027	7,061
Bulk Amoxycillin	- Imported	7,915	12,595	17,693	22,248	26,137
Bulk Cloxacillin	- Imported	833	1,590	2,443	3,319	4,146
Final Dosage Forms	- Imported	761	1,668	2,351	3,179	3,940
		111,502	176,959	222,439	228,964	233,088
1.2 Utilities						
Fermentation/Extraction		35,277	56,029	69,862	69,862	69,862
6-APA Production		354	556	681	654	621
Bulk Ampicillin		424	603	701	872	880
Bulk Amoxycillin		937	1,483	2,086	2,624	3,081
Bulk Cloxacillin		53	101	154	207	260
Final Dosage Forms		280	595	840	1,120	1,400
		37,325	59,367	74,324	75,339	76,104
2. Direct Manpower		10,180	10,180	10,180	10,180	10,180
3. Factory Overheads						
Manpower		7,800	7,800	7,800	7,800	7,800
Replacement Spare Parts		11,428	11,999	12,599	13,229	13,890
Repairs & Maintenance		4,679	7,639	9,764	10,435	11,029
Protective Clothing, etc		1,300	1,300	1,300	1,300	1,300
		25,207	28,738	31,463	32,764	34,019
4. Administrative Overheads						
Manpower		5,050	5,050	5,050	5,050	5,050
Insurance		10,461	10,461	10,461	10,461	10,461
Office Supplies		650	650	650	650	650
Communications		650	650	650	650	650
Land/Property Charges		156	156	156	156	156
Technology Transfer		1,950	1,950	1,950	1,950	1,950
Licences & Fees		130	130	130	130	130
Travel & Transport		400	400	400	400	400
Sundries		583	583	583	583	583
		20,030	20,030	20,030	20,030	20,030

DETAILED PRODUCTION COST SCHEDULE Continued

Year	1995	1996	1997	1998	1999
5. Sales & Distribution Costs					
Manpower	6,285	6,285	6,285	6,285	6,285
Product Promotion	1,889	2,456	2,891	3,419	3,946
Travel	620	620	620	620	620
Office Rental	750	750	750	750	750
Sales Commissions	252	535	753	1,017	1,281
	9,796	10,646	11,299	12,091	12,882
6. Financial Costs					
Foreign Currency Loans	75,103	67,592	52,572	37,552	22,531
Local Currency Loans	0	11,456	9,547	5,728	1,909
	75,103	79,048	62,119	43,280	24,440
7. Depreciation					
Buildings	22,745	22,745	22,745	22,745	22,745
Plant, Machinery & Equipment	28,570	28,570	28,570	28,570	28,570
Vehicles	1,386	1,386	1,386	1,386	1,386
Service Equipment	1,287	1,287	1,287	1,287	1,287
Intangibles	93,412	93,412	93,412	93,412	93,411
	147,400	147,400	147,400	147,400	147,399
Total Production Cost	436,543	532,368	579,254	570,048	558,142

APPENDIX 10-8

PRODUCTION COST SCHEDULE : OPTION A

1. Direct Materials and Inputs

1.1 Expenditure on raw material inputs has been calculated by reference to the detailed production schedule presented at Appendix 3-30, and the following usage and cost figures :

Penicillin

	kg/batch*	cost/tonne
Imported Fermentation Materials		
- Calcium Carbonate	15,157	$ 270
- Sodium Sulphate	9,549	$ 146
- Potassium Hydrogen Phosphate	909	$ 1,992
- Ammonium Sulphate	7,650	$ 26
- Ammonia Gas	940	$ 184
- Sulphuric Acid	1,440	$ 35
- Phenyl Acetic Acid Salt	9,900	$ 1,086
Local Fermentation Materials		
- Corn Steep Liquor	60,633	P 8,900
- Soy Bean Oil (medium)	4,729	P 21,000
- Soy Bean Oil (feedings)	1,260	P 21,000
- Sucrose Solution	50,400	P 3,675
Imported Extraction Materials		
- Butyl Acetate	5,530	$ 1,500
- Active Carbon	17	$ 996
- Sodium Bicarbonate	809	$ 881
- Butanol	2,390	$ 1,166

* production per batch = 2,584 kg of penicillin (net of 10% losses in production)

6-APA

	kg/tonne	cost/tonne
Imported Production Materials		
- Dichloromethane	6,000	$ 905
- Ammonia	1,500	$ 190
- Hydrochloric Acid 30%	2,000	$ 90
- Acetone	2,500	$ 1,200

Ampicillin

	kg/tonne	cost/tonne
Imported Production Materials		
- Acetone	680	$ 1,200
- Dichloromethane	960	$ 905
- Methyl Iso Butyl Ketone	400	$ 1,560
- Triethylamine	340	$ 3,895
- Ethylchlorocarbonate	372	$ 17,400
- Phenylglycine	491	$ 25,600
- Potassium Hydroxide	172	$ 4,870
- Ethanol	156	$ 1,182
- Ethylacetoacetate	440	$ 3,270

Amoxycillin

Imported Production Materials	kg/tonne	cost/tonne
- Acetone	700	$ 1,200
- Dichloromethane	960	$ 905
- Methyl Iso Butyl Ketone	400	$ 1,560
- Triethylamine	330	$ 3,895
- Ethylchlorocarbonate	360	$ 17,400
- Phenylglycine	551	$ 25,600
- Potassium Hydroxide	183	$ 4,870
- Ethanol	166	$ 1,182
- Ethylacetoacetate	470	$ 3,270

Cloxacillin

Imported Production Materials	kg/tonne	cost/tonne
- Acetone	1,250	$ 1,200
- Methyl Iso Butyl Ketone	2,500	$ 1,560
- Acid Chloride	714	$ 21,000
- Sodium Hydroxide	116	$ 9,660
- Sodium Hexanoate	480	$ 16,365

Final Dosage Forms

Imported Packaging Materials	% of sales	cost/tonne
- Capsules	70%	$ 30,129
- Syrups	30%	$ 56,000

1.2 It may be noted that all raw material costs are quoted per tonne of active ingredient, delivered to the factory site. In the case of imported materials, provision has also been made in the cost for payment of 10% customs duties.

1.3 Expenditure on utilities has been calculated by reference to the detailed production schedule presented at Appendix 3-30, and the following usage and cost figures :

Penicillin

Utilities	units/batch*	cost/unit
- Steam (tonnes)	120	P 600
- Power (Mwh)	279	P 2,220
- Water (cu.metres)	135	P 3

* production per batch = 2,584 kg of penicillin (net of 10% losses in production)

All Other Products

Steam/Power/Water	cost/tonne of product
- 6-APA	P 5,450
- Ampicillin	P 81,500
- Amoxycillin	P 81,500
- Cloxacillin	P 48,200
- Final Dosage Forms	P 350,000

2. Direct Manpower

2.1 The wage and salary cost of the production staff employed in the factory has been estimated at a total of just under P 10.2 million per annum. This figure may be broken down as follows :

	Number	Salary	Annual Cost
Direct Production Staff			
- Production Supervisors	15	180,000	2,700,000
- Technicians	33	120,000	3,960,000
- Skilled Workers	28	80,000	2,240,000
- Unskilled Labour	32	40,000	1,280,000
Total	108		10,180,000

3. Factory Overheads

3.1 The wage and salary cost of the laboratory and engineering staff employed in the factory has been estimated at a total of P 7.8 million per annum. This figure may be broken down as follows :

	Number	Salary	Annual Cost
Laboratory/Engineering Staff			
- Supervisors	16	180,000	2,880,000
- Technicians	17	120,000	2,040,000
- Skilled Workers	26	80,000	2,080,000
- Unskilled Labour	20	40,000	800,000
Total	79		7,800,000

3.2 The provision made for the importation of replacement spare parts has been calculated at 2% of the initial value of the production and auxiliary machinery and equipment to be installed in the factory. However, this figure has then been projected to rise at a compound growth rate of 5% per annum to cover the expected increase in servicing needs over time.

3.3 The provision made for repairs and maintenance has been calculated at the rate of 3% by reference to projected sales revenues in each year.

3.4 Additional provision has been made for annual expenditures totalling P 1.3 million on protective clothing and sundry other consumables such as cleaning materials, lubricants and loose tools used within the factory complex.

4. Administrative Overheads

4.1 The wage and salary cost of the senior management team and the administration and other personnel employed has been estimated at a total of P 5.05 million per annum. This figure may be broken down as follows :

	Number	Salary	Annual Cost
Senior Management			
- Chief Executive	1	800,000	800,000
- Directors	2	500,000	1,000,000
- Production/Lab/Engineering	5	250,000	1,250,000
- Commercial/Administration	2	250,000	500,000
Administration/Other Personnel			
- Accounts Officer	1	120,000	120,000
- Storekeepers	4	60,000	240,000
- Secretaries	4	60,000	240,000
- Security Officers	2	60,000	120,000
- Clerical Staff	8	40,000	320,000
- Drivers	5	40,000	200,000
- Receptionists	2	30,000	60,000
- Watchmen	8	25,000	200,000
Total	44		5,050,000

4.2 The cost of insuring the factory and other buildings, plus all the plant, machinery and equipment installed therein and the project vehicles, against fire, theft and accidental damage has been estimated at 1% of the initial value of the assets. The figure quoted of approximately P 10.5 million should also include the cost of providing accident cover for the workforce.

4.3 Various provisions totalling just under P 2 million have been specified to cover annual expenditures on office supplies, communications, land/property charges, licences, fees and travel/transport.

4.4 It has been assumed that the project would be required to make an annual payment of $ 75,000 in respect of technology transfer for the strain development programme for penicillin production in each of the first five years of operation.

4.5 Finally, provision has been made for what is, in effect, a contingency allowance, calculated at 3% of total overhead costs, to cover those items which have not been separately specified (such as donations, entertainment, staff medical and canteen expenses and the like).

5. <u>Sales and Distribution Costs</u>

5.1 The wage and salary cost of the sales and distribution team employed both within the factory complex and in the field has been estimated at a total of just under P 6.3 million per annum. This figure may be broken down as follows :

	Number	Salary	Annual Cost
Management			
- Sales Directors	2	500,000	1,000,000
- Sales Managers	2	250,000	500,000
Other Personnel			
- Salesman (Pen-G & 6-APA)	1	180,000	180,000
- Sales Supervisors	3	180,000	540,000
- Sales Representatives	25	144,000	3,600,000
- Sales Administrator	1	120,000	120,000
- Senior Secretary	1	60,000	60,000
- Secretaries	4	35,000	140,000
- Clerical Staff	4	30,000	120,000
- Receptionist	1	25,000	25,000
Total	44		6,285,000

5.2 The figures quoted in respect of product promotion, travel and transport, office rental and sales commissions have been taken directly from the detailed cost schedule presented at Appendix 3-28 (Option A refers).

6. <u>Financial Costs</u>

6.1 It has been assumed that the foreign currency loans would be made available on the basis of the following terms and conditions :

Loan Amount	:	P 938,787,000, equivalent to just over $ 36.1 million.
Loan Term	:	6 years, inclusive of a grace period of one year.
Loan Drawdown	:	final tranche drawn by mid-1995.
Interest Rate	:	8% per annum, payable on the balance outstanding.
Repayment	:	in five equal annual instalments, commencing one year after final drawdown (that is, by mid-1996).

6.2 It has been assumed that the local currency loans would be made available on the basis of the following terms and conditions :

Loan Amount	:	P 45,824,000, equivalent to just under $ 1.8 million.
Loan Term	:	4 years, inclusive of a grace period of one year.
Loan Drawdown	:	by mid-1996.
Interest Rate	:	25% per annum, payable on the balance outstanding.
Repayment	:	in three equal annual instalments, commencing one year after drawdown (that is, by mid-1997).

7. Depreciation

7.1 Depreciation in respect of the proposed investment has been calculated on a straight line basis in accordance with the following rates :

Buildings and Civil Works	:	5%
Auxiliary and Service Facilities	:	5%
Production Equipment	:	5%
Ancillary Production Equipment	:	5%
Auxiliary Equipment	:	5%
Vehicles	:	20%
Service Equipment	:	10%
Intangibles *	:	20%

* incorporated fixed assets and pre-production capital expenditure

UNIDO PENICILLIN PROJECT : OPTION A

Appendix 10-9

NET INCOME STATEMENT

in Pesos '000

Year	1995	1996	1997	1998	1999
1. Sales Revenues	155,965	254,620	325,475	347,818	367,628
2. Operating Costs	214,040	305,920	369,735	379,368	386,303
3. Operating Profit/(Loss)	(58,075)	(51,300)	(44,260)	(31,550)	(18,675)
4. Financial Costs	75,103	79,048	62,119	43,280	24,440
5. Depreciation	147,400	147,400	147,400	147,400	147,399
6. Gross Profit/(Loss) before Tax	(280,578)	(277,748)	(253,779)	(222,230)	(190,514)
7. Corporate Taxation	0	0	0	0	0
8. Net Profit/(Loss)	(280,578)	(277,748)	(253,779)	(222,230)	(190,514)
9. Dividends	0	0	0	0	0
10. Retained Profits	(280,578)	(277,748)	(253,779)	(222,230)	(190,514)
11. Revenue Reserves	(280,578)	(558,326)	(812,105)	(1,034,335)	(1,224,849)
Gross Profit : Sales	-179.9%	-109.1%	-78.0%	-63.9%	-51.8%
Net Profit : Equity	-41.7%	-41.3%	-37.7%	-33.0%	-28.3%

APPENDIX 10-9

NET INCOME STATEMENT : OPTION A

1. Sales Revenues

1.1 The figures quoted in respect of sales revenues have been taken directly from the detailed schedules presented at Appendices 3-26 and 3-27 (Option A refers).

2. Operating Costs, Financial Costs and Depreciation

2.1 The figures quoted in respect of operating costs, financial costs and depreciation have all been taken directly from the production cost schedule presented at Appendix 10-8a.

3. Taxation

3.1 It has been assumed that the project would be successful in negotiating an initial tax holiday of six years from the commencement of commercial operations.

3.2 However, the extent of the losses anticipated over this period is such that, in effect, this tax exemption becomes immaterial.

4. Dividends

4.1 Given the magnitude of the losses anticipated, the project would not be in a position to declare dividends throughout the period under review.

5. Revenue Reserves

5.1 The revenue reserves reflect the accumulated loss position of the project, and the changes thereto, as reflected in the income statement and final loss figure for each year.

UNIDO PENICILLIN PROJECT : OPTION A

Appendix 10-10

CASH FLOW TABLE FOR FINANCIAL PLANNING

in Pesos '000

Year	1993	1994	1995	1996	1997	1998	1999
CASH INFLOW	706,540	800,000	275,507	307,736	330,511	348,447	368,035
1. Financial Resources	706,540	800,000	117,542	53,116	5,036	629	407
2. Sales Revenues	0	0	155,965	254,620	325,475	347,818	367,628
CASH OUTFLOW	(383,406)	(1,082,034)	(442,913)	(610,206)	(660,430)	(629,747)	(616,380)
1. Total Assets Schedule	(383,406)	(1,082,034)	(153,770)	(37,481)	(25,544)	(4,067)	(2,606)
2. Operating Costs	0	0	(214,040)	(305,920)	(369,735)	(379,368)	(386,303)
3. Debt Service : Interest							
- Foreign Currency Loans	0	0	(75,103)	(67,592)	(52,572)	(37,552)	(22,531)
- Local Currency Loans	0	0	0	(11,456)	(9,547)	(5,728)	(1,909)
Debt Service : Repayments							
- Forex Loan	0	0	0	(187,757)	(187,757)	(187,757)	(187,757)
- Local Loan	0	0	0	0	(15,275)	(15,275)	(15,274)
4. Corporate Tax	0	0	0	0	0	0	0
5. Dividends	0	0	0	0	0	0	0
SURPLUS/(DEFICIT)	323,134	(282,034)	(169,406)	(302,470)	(329,919)	(281,300)	(248,345)
CUMULATIVE CASH SHORTFALL	323,134	41,100	(128,306)	(430,776)	(760,695)	(1,041,995)	(1,290,340)

APPENDIX 10-10

CASH FLOW TABLE FOR FINANCIAL PLANNING : OPTION A

1. Cash Inflow

1.1 The figures quoted in respect of financial resources have been taken directly from the initial financing plan detailed in Appendix 10-7, and reflect the sum of the subscription for equity in the project, the foreign and local currency loans drawndown and the increase in current liabilities in each year.

1.2 The figures quoted in respect of sales revenues have been taken directly from the net income statement presented at Appendix 10-9.

2. Cash Outflow

2.1 The figures quoted in respect of total assets have been taken directly from the total assets schedule detailed in Appendix 10-6, and reflect the sum of the initial investment costs, pre-production capital expenditures and the increase in current assets in each year.

2.2 The figures quoted in respect of operating costs have been taken directly from the net income statement presented at Appendix 10-9.

2.3 The figures quoted in respect of debt service have been calculated on the basis of the terms and conditions assumed for the foreign and local currency loans, as respectively detailed in sections 6.1 and 6.2 of Appendix 10-9 :

Foreign Currency Loans
Interest Rate : 8% per annum, payable on the balance outstanding.
Repayment : in five equal annual instalments, commencing one year after final drawdown (that is, by mid-1996).

Local Currency Loans
Interest Rate : 25% per annum, payable on the balance outstanding.
Repayment : in three equal annual instalments, commencing one year after drawdown (that is, by mid-1997).

2.4 Neither taxation nor dividends would be payable throughout the period under review.

COAL BREEZE LIMITED for

MANDERSTAM CONSULTING SERVICES

OPTION 1 - FULL PROCESS

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILLIN G - UNIDO - PHILIPPINES

DATE Jan 92

PRIME CASE i.e. FILIPINO BUILD

DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB-CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB-CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
EQUIPMENT PROCUREMENT																
MEDIA PREPARATION																
MP1 CORN STEEP LIQUOR RECEPTION TANK	EA	1.0	0.0	0.0	1.0	64,260	64.3	1.0		0			0.0	0.0	64.3	
MP2 CORN STEEP LIQUOR TRANSFER PUMP	EA	1.0	0.0	0.0	1.0	119,000	119.0	1.0		0			0.0	0.0	119.0	
MP3 BAG OPENING MACHINE	EA	1.0	0.0	0.0	1.0	24,500	24.5	1.0		0			0.0	0.0	24.5	
MP4 WEIGHING HOPPER	EA	1.0	0.0	0.0	1.0	8,750	8.8	1.0		0			0.0	0.0	8.8	
MP5 MEDIA MAKE UP TANK	EA	1.0	0.0	0.0	1.0	53,550	53.6	1.0		0			0.0	0.0	53.6	
MP6 MEDIA DELIVERY PUMP	EA	1.0	0.0	0.0	1.0	119,000	119.0	1.0		0			0.0	0.0	119.0	
MP7 MEDIA STERILISATION PLANT	EA	1.0	0.0	0.0	1.0	297,500	297.5	1.0		0			0.0	0.0	297.5	
MP8 DRUM EMPTYING PUMP	EA	1.0	0.0	0.0	1.0	4,900	4.9	1.0		0			0.0	0.0	4.9	
WEIGHBRIDGE	EA	1.0	0.0	0.0	1.0	49,000	49.0	1.0		0			0.0	0.0	49.0	
SPIRAL HEATER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	INCLUDED IN MP7
SPIRAL INTERCHANGER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	INCLUDED IN MP7
SPIRAL COOLER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	INCLUDED IN MP7
HOLDING TUBE	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	INCLUDED IN MP7
BALANCE TANK	EA	1.0	0.0	0.0	1.0	10,500	10.5	1.0		0			0.0	0.0	10.5	
SUB TOTAL - MEDIA PREPARATION							751.0			0			0.0	0.0	751.0	
ADDITIVE PREPARATION																
AP1 SUGAR STERILISER	EA	1.0	0.0	0.0	1.0	35,000	35.0	1.0		0			0.0	0.0	35.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	19,040	19.0	1.0		0			0.0	0.0	19.0	
AP2 PHENYL ACETATE STERILISER	EA	1.0	0.0	0.0	1.0	21,000	21.0	1.0		0			0.0	0.0	21.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	14,000	14.0	1.0		0			0.0	0.0	14.0	
AP3 AMMONIUM SULPHATE STERILISER	EA	1.0	0.0	0.0	1.0	35,000	35.0	1.0		0			0.0	0.0	35.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	19,040	19.0	1.0		0			0.0	0.0	19.0	
AP4 SOYA BEAN OIL STERILISER	EA	1.0	0.0	0.0	1.0	35,000	35.0	1.0		0			0.0	0.0	35.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	19,040	19.0	1.0		0			0.0	0.0	19.0	
AP5 CAUSTIC POTASH or SODA STERILISER	EA	1.0	0.0	0.0	1.0	35,000	35.0	1.0		0			0.0	0.0	35.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	19,040	19.0	1.0		0			0.0	0.0	19.0	
AIR FILTER	EA	5.0	0.0	0.0	5.0	1,750	8.8	5.0		0			0.0	0.0	8.8	
AIR PREFILTER	EA	5.0	0.0	0.0	5.0	1,180	6.0	5.0		0			0.0	0.0	6.0	
STEAM COILS	EA	5.0	0.0	0.0	5.0	3,500	17.5	5.0		0			0.0	0.0	17.5	
SUB TOTAL - ADDITIVE PREPARATION							283.4			0			0.0	0.0	283.4	
PENICILLIN FERMENTATION																
PF1 FERMENTER	EA	3.0	0.0	0.0	3.0	140,000	420.0	3.0		0			0.0	0.0	420.0	
PF2 AGITATOR FOR ABOVE	EA	3.0	0.0	0.0	3.0	99,400	298.2	3.0		0			0.0	0.0	298.2	
PF3 AIR & STEAM STERILISER	EA	3.0	0.0	0.0	3.0	71,400	214.2	3.0		0			0.0	0.0	214.2	
PF4 SEED FERMENTER	EA	3.0	0.0	0.0	3.0	16,100	48.3	3.0		0			0.0	0.0	48.3	
PF5 AGITATOR FOR ABOVE	EA	3.0	0.0	0.0	3.0	19,040	57.1	3.0		0			0.0	0.0	57.1	
PF6 SEED FERMENTER AIR STERILISER	EA	3.0	0.0	0.0	3.0	7,210	21.6	3.0		0			0.0	0.0	21.6	
PF7 PILOT FERMENTER	EA	3.0	0.0	0.0	3.0	350,000	1,050.0	3.0		0			0.0	0.0	1,050.0	
AGITATOR FOR ABOVE	EA	3.0	0.0	0.0	3.0	19,040	57.1	3.0		0			0.0	0.0	57.1	
PF8 CONTROL SCHEME	EA	1.0	0.0	0.0	1.0		0.0	1.0		0			0.0	0.0	0.0	INC IN CONTROL SYSTEM S/C
PF9 FERMENTER DISCHARGE PUMP	EA	3.0	0.0	0.0	3.0	120,400	361.2	3.0		0			0.0	0.0	361.2	
AIR COMPRESSOR	EA	3.0	0.0	0.0	3.0	14,000	42.0	3.0		0			0.0	0.0	42.0	
AIR FILTER	EA	9.0	0.0	0.0	9.0	1,750	15.8	9.0		0			0.0	0.0	15.8	
AIR PREFILTER	EA	9.0	0.0	0.0	9.0	1,180	10.7	9.0		0			0.0	0.0	10.7	
SUB TOTAL - PENICILLIN FERMENTATION							2,598.2			0			0.0	0.0	2,598.2	

COAL BREEZE LIMITED for

HANDERSTAM CONSULTING SERVICES

OPTION 1 FULL PROCESS

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILLIN G - UNIDO - PHILLIPINES

DATE Jan 97
SHEET 2 of 6
PRIME CASE A I.e. FILIPINO BUILD

DESCRIPTION		UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB-CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB-CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
EQUIPMENT PROCUREMENT contd																	
DOWNSTREAM RECOVERY																	
DR1	HARVEST VESSEL	EA	1.0	0.0	0.0	1.0	82,400	82.4	1.0		0			0.0	0.0	82.4	
DR2	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	53,550	53.6	1.0		0			0.0	0.0	53.6	
DR3	HARVEST VESSEL DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	14,000	14.0	1.0		0			0.0	0.0	14.0	
DR4	PREFILTER TREATMENT VESSEL	EA	2.0	0.0	0.0	2.0	21,000	42.0	2.0		0			0.0	0.0	42.0	
	AGITATOR FOR ABOVE	EA	2.0	0.0	0.0	2.0	10,500	21.0	2.0		0			0.0	0.0	21.0	
DR5	ROTARY VACUUM FILTER	EA	1.0	0.0	0.0	1.0	71,400	71.4	1.0		0			0.0	0.0	71.4	
DR6	FILTERED BROTH SEPARATOR	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
DR7	FILTERED BROTH RECEIVER	EA	1.0	0.0	0.0	1.0	33,600	33.6	1.0		0			0.0	0.0	33.6	
DR8	PRIMARY CENTRIFUGAL EXTRACTOR	EA	1.0	0.0	0.0	1.0	105,000	105.0	1.0		0			0.0	0.0	105.0	
DR9	PRIMARY EXTRACTOR FEED PUMP	EA	1.0	0.0	0.0	1.0	14,000	14.0	1.0		0			0.0	0.0	14.0	
DR10	FILTERED BROTH COOLER	EA	1.0	0.0	0.0	1.0	35,000	35.0	1.0		0			0.0	0.0	35.0	
DR11	DE EMULSIFIER VESSEL	EA	1.0	0.0	0.0	1.0	10,500	10.5	1.0		0			0.0	0.0	10.5	
DR12	DE EMULSIFIER METERING PUMP	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
DR13	SPENT BROTH SURGE VESSEL	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
DR14	SULPHURIC ACID MAKE UP VESSEL	EA	1.0	0.0	0.0	1.0	14,000	14.0	1.0		0			0.0	0.0	14.0	POLY ETHELYENE
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
DR15	SULPHURIC ACID FEED PUMP	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
DR16	DILUTED CAUSTIC VESSEL	EA	1.0	0.0	0.0	1.0	4,760	4.8	1.0		0			0.0	0.0	4.8	CARBON STEEL
DR17	BUTYL ACETATE FEED VESSEL	EA	1.0	0.0	0.0	1.0	11,200	11.2	1.0		0			0.0	0.0	11.2	
DR18	BUTYL ACETATE FEED PUMP	EA	2.0	0.0	0.0	2.0	7,140	14.3	2.0		0			0.0	0.0	14.3	
	AIR FILTER	EA	2.0	0.0	0.0	2.0	1,750	3.5	2.0		0			0.0	0.0	3.5	
	AIR PREFILTER	EA	2.0	0.0	0.0	2.0	1,190	2.4	2.0		0			0.0	0.0	2.4	
	ADDITIVE VESSEL	EA	2.0	0.0	0.0	2.0	7,000	14.0	2.0		0			0.0	0.0	14.0	
	AGITATOR FOR ABOVE	EA	2.0	0.0	0.0	2.0	3,500	7.0	2.0		0			0.0	0.0	7.0	
	K/O DRUM	EA	2.0	0.0	0.0	2.0	7,000	14.0	2.0		0			0.0	0.0	14.0	
	VACUUM PUMP	EA	2.0	0.0	0.0	2.0	4,760	9.5	2.0		0			0.0	0.0	9.5	
	MYCELIUM DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	4,000	4.9	1.0		0			0.0	0.0	4.9	
	FILTERED BROTH DISCHARGE PUMP	EA	2.0	0.0	0.0	2.0	4,900	9.8	2.0		0			0.0	0.0	9.8	
	SPENT BROTH DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	4,900	4.9	1.0		0			0.0	0.0	4.9	
	BUTYL ACETATE COOLER	EA	1.0	0.0	0.0	1.0	14,000	14.0	1.0		0			0.0	0.0	14.0	
	BUTYL ACETATE FILTER	EA	2.0	0.0	0.0	2.0	1,750	3.5	2.0		0			0.0	0.0	3.5	
	WASHING WATER FILTER	EA	1.0	0.0	0.0	1.0	1,190	1.2	1.0		0			0.0	0.0	1.2	
SUB TOTAL - DOWNSTREAM RECOVERY								660.4			0			0.0	0.0	660.4	

COAL BREEZE LIMITED for

MANDERSTAM CONSULTING SERVICES

OPTION 1 - FULL PROCESS

ORDER OF MAGNITUDE COST ESTIMATE for PENICILLIN G - UNIDO - PHILLIPINES

DATE Jan 92

SHEET 3 of 8

PRIME CASE A1 + FILIPINO BUILD

DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB-CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB-CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
EQUIPMENT PROCUREMENT contd...																
PENICILIN PURIFICATION																
PP1 SPENT BUTYL ACETATE VESSEL	EA	1.0	0.0	0.0	1.0	17,500	17.5	1.0		0			0.0	0.0	17.5	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	8,750	8.8	1.0		0			0.0	0.0	8.8	
PP2 RICH BUTYL ACETATE VESSEL	EA	2.0	0.0	0.0	2.0	14,000	28.0	2.0		0			0.0	0.0	28.0	
AGITATOR FOR ABOVE	EA	2.0	0.0	0.0	2.0	7,000	14.0	2.0		0			0.0	0.0	14.0	
PP3 BUFFER MAKE UP VESSEL	EA	1.0	0.0	0.0	1.0	49,000	49.0	1.0		0			0.0	0.0	49.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	24,500	24.5	1.0		0			0.0	0.0	24.5	
PP4 BUTYL ACETATE & BUFFER SURGE VES	EA	1.0	0.0	0.0	1.0	22,400	22.4	1.0		0			0.0	0.0	22.4	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	11,200	11.2	1.0		0			0.0	0.0	11.2	
PP5 BUTYL ACETATE & BUFFER FEED PUMP	EA	1.0	0.0	0.0	1.0	14,350	14.3	1.0		0			0.0	0.0	14.3	
PP6 SECOND'Y CENTRIFUGAL EXTRACTOR	EA	1.0	0.0	0.0	1.0	28,000	28.0	1.0		0			0.0	0.0	28.0	
SECONDARY EXTRACTOR FEED PUMP	EA	1.0	0.0	0.0	1.0	4,200	4.2	1.0		0			0.0	0.0	4.2	
PP7 RICH PENICILIN SURGE VESSEL	EA	1.0	0.0	0.0	1.0	11,200	11.2	1.0		0			0.0	0.0	11.2	
PP8 RICH PENICILIN DILUTION VESSEL	EA	1.0	0.0	0.0	1.0	17,500	17.5	1.0		0			0.0	0.0	17.5	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	8,750	8.8	1.0		0			0.0	0.0	8.8	
PP9 BUTANOL SUPPLY VESSEL	EA	1.0	0.0	0.0	1.0	11,200	11.2	1.0		0			0.0	0.0	11.2	
PP10 PENICILIN CRYSTALISER	EA	1.0	0.0	0.0	1.0	17,500	17.5	1.0		0			0.0	0.0	17.5	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	8,750	8.8	1.0		0			0.0	0.0	8.8	
PP11 PENICILIN CRYSTALISER SLURRY VES	EA	1.0	0.0	0.0	1.0	17,500	17.5	1.0		0			0.0	0.0	17.5	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	8,750	8.8	1.0		0			0.0	0.0	8.8	
PP12 PENICILIN FILTER	EA	1.0	0.0	0.0	1.0	71,400	71.4	1.0		0			0.0	0.0	71.4	
PP13 PENICILIN DRYER	EA	1.0	0.0	0.0	1.0	59,500	59.5	1.0		0			0.0	0.0	59.5	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	29,750	29.7	1.0		0			0.0	0.0	29.7	
PP14 RICH BUTYL ACETATE FILTER	EA	1.0	0.0	0.0	1.0	24,500	24.5	1.0		0			0.0	0.0	24.5	
PP15 BUFFER SOLUTION FEED PUMP	EA	1.0	0.0	0.0	1.0	14,350	14.3	1.0		0			0.0	0.0	14.3	
BUTYL ACETATE RECOVERY PUMP	EA	1.0	0.0	0.0	1.0	4,900	4.9	1.0		0			0.0	0.0	4.9	
CARBON FEED HOPPER	EA	2.0	0.0	0.0	2.0	4,760	9.5	2.0		0			0.0	0.0	9.5	
CARBON FEED SCREW CONVEYOR	EA	2.0	0.0	0.0	2.0	17,500	35.0	2.0		0			0.0	0.0	35.0	
RICH BUTYL ACETATE FEED PUMP	EA	1.0	0.0	0.0	1.0	10,500	10.5	1.0		0			0.0	0.0	10.5	
FILTERED BROTH DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	4,900	4.9	1.0		0			0.0	0.0	4.9	
BUTYL ACETATE & BUFFER CONTACT'R	EA	1.0	0.0	0.0	1.0	4,900	4.9	1.0		0			0.0	0.0	4.9	
SEPARATOR VESSEL	EA	1.0	0.0	0.0	1.0	14,000	14.0	1.0		0			0.0	0.0	14.0	
pH METER SURGE VESSEL	EA	1.0	0.0	0.0	1.0	1,400	1.4	1.0		0			0.0	0.0	1.4	
RICH PENICILIN FEED PUMP 4M3/HR	EA	1.0	0.0	0.0	1.0	4,900	4.9	1.0		0			0.0	0.0	4.9	
RICH PENICILIN FEED PUMP 8M3/HR	EA	1.0	0.0	0.0	1.0	8,400	8.4	1.0		0			0.0	0.0	8.4	
BUTANOL FILTER	EA	1.0	0.0	0.0	1.0	3,500	3.5	1.0		0			0.0	0.0	3.5	
PENICILIN SOLUTION FILTER	EA	1.0	0.0	0.0	1.0	3,500	3.5	1.0		0			0.0	0.0	3.5	
VACUUM SYSTEM	EA	2.0	0.0	0.0	2.0	119,000	238.0	2.0		0			0.0	0.0	238.0	
BUTANOL VESSEL	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
SOLVENT CONDENSER	EA	1.0	0.0	0.0	1.0	10,500	10.5	1.0		0			0.0	0.0	10.5	
SPENT SOLUTION CONDENSER	EA	1.0	0.0	0.0	1.0	10,500	10.5	1.0		0			0.0	0.0	10.5	
SPENT SOLUTION PRECONDENSER	EA	1.0	0.0	0.0	1.0	14,000	14.0	1.0		0			0.0	0.0	14.0	
OVERHEAD ACCUMULATOR	EA	1.0	0.0	0.0	1.0	10,500	10.5	1.0		0			0.0	0.0	10.5	
SPENT SOLVENT SURGE VESSEL	EA	1.0	0.0	0.0	1.0	10,500	10.5	1.0		0			0.0	0.0	10.5	
SPENT SOLVENT DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	4,900	4.9	1.0		0			0.0	0.0	4.9	
DISTILLATE COOLER	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
DISTILLATE FEED PUMP	EA	1.0	0.0	0.0	1.0	4,900	4.9	1.0		0			0.0	0.0	4.9	
WEIGHER	EA	1.0	0.0	0.0	1.0	1,050	1.1	1.0		0			0.0	0.0	1.1	
SUB TOTAL - PENICILIN PURIFICATION							946.8			0			0.0	0.0	946.8	

COAL BREEZE LIMITED for

MANDERSTAM CONSULTING SERVICES

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILLIN G - UNIDO - PHILIPPINES

DATE Jan 02
SHEET 4 of 6
PRIME CASE A I e FILIPINO BUILD

OPTION 1 FULL PROCESS

DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB-CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB-CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
EQUIPMENT PROCUREMENT contd...																
6 APA PLANT																
APA1 PENICILLIN MAKE UP TANK	EA	1.0	0.0	0.0	1.0	17,500	17.5	1.0		0			0.0	0.0	17.5	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	8,750	8.8	1.0		0			0.0	0.0	8.8	
APA2 SCREW FEEDER	EA	1.0	0.0	0.0	1.0	4,200	4.2	1.0		0			0.0	0.0	4.2	
APA3 PENICILLIN DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	47,600	47.6	1.0		0			0.0	0.0	47.6	
APA4 ENZYME REACTOR	EA	1.0	0.0	0.0	1.0	28,000	28.0	1.0		0			0.0	0.0	28.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	14,000	14.0	1.0		0			0.0	0.0	14.0	
APA5 ENZYME RECOVERY FILTER	EA	1.0	0.0	0.0	1.0	17,500	17.5	1.0		0			0.0	0.0	17.5	
APA6 ENZYME RECOVERY FEED PUMP	EA	1.0	0.0	0.0	1.0	14,350	14.3	1.0		0			0.0	0.0	14.3	
APA7 EVAPORATOR FEED TANK	EA	1.0	0.0	0.0	1.0	10,710	10.7	1.0		0			0.0	0.0	10.7	
APA8 CRYSTALISER FEED PUMP (GEAR)	EA	1.0	0.0	0.0	1.0	3,500	3.5	1.0		0			0.0	0.0	3.5	
APA9 CRYSTALISER	EA	2.0	0.0	0.0	2.0	10,500	21.0	2.0		0			0.0	0.0	21.0	
AGITATOR FOR ABOVE	EA	2.0	0.0	0.0	2.0	5,250	10.5	2.0		0			0.0	0.0	10.5	
APA10 BELT FILTER/WASHER	EA	1.0	0.0	0.0	1.0	7,140	7.1	1.0		0			0.0	0.0	7.1	
APA11 FLUID BED DRYER	EA	1.0	0.0	0.0	1.0	63,000	63.0	1.0		0			0.0	0.0	63.0	
APA12 EVAPORATOR	EA	1.0	0.0	0.0	1.0	24,500	24.5	1.0		0			0.0	0.0	24.5	
APA13 EVAPORATOR FEED PUMP	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
SUB TOTAL - 6 APA PLANT							299.3			0			0.0	0.0	299.3	
EQUIPMENT PROCUREMENT SUMMARY																
SUB TOTAL - MEDIA PREPARATION							751.0			0			0.0	0.0	751.0	FROM SHEET 1
SUB TOTAL - ADDITIVE PREPARATION							283.4			0			0.0	0.0	283.4	FROM SHEET 1
SUB TOTAL - PENICILLIN FERMENTATION							2,598.2			0			0.0	0.0	2,598.2	FROM SHEET 1
SUB TOTAL - DOWNSTREAM RECOVERY							660.4			0			0.0	0.0	660.4	FROM SHEET 2
SUB TOTAL - PENICILLIN PURIFICATION							948.8			0			0.0	0.0	948.8	FROM SHEET 3
SUB TOTAL - 6 APA PLANT							299.3			0			0.0	0.0	299.3	FROM SHEET 4 (THIS SHEET)
SUB TOTAL FLOWSHEET BASED							5,537.0			0			0.0	0.0	5,537.0	
ALLOW - MISC MECHANICAL HANDLING	PS	1.0	0.0	0.0	1.0	70,000	70.0	1.0		0			0.0	0.0	70.0	MISC HOISTS/GANTRIES etc
- UTILITIES	PS	1.0	0.0	0.0	1.0	4,141,800	4,141.8	1.0		0			0.0	0.0	4,141.8	SEE SEPARATE ESTIMATE
ALLOW - POWER GENERATION	PS	1.0	0.0	0.0	1.0	INC	0.0	1.0		0			0.0	0.0	0.0	INC IN UTILITIES
ALLOW - DUST EXTRACTION	PS	1.0	0.0	0.0	1.0	INC	0.0	1.0		0			0.0	0.0	0.0	INC IN DOSAGE
ALLOW - CONDITIONING SYSTEMS	PS	1.0	0.0	0.0	1.0	INC	0.0	1.0		0			0.0	0.0	0.0	INC IN DOSAGE
ALLOW - BAGGING & PALLETISING	PS	1.0	0.0	0.0	1.0	INC	0.0	1.0		0			0.0	0.0	0.0	INC IN DOSAGE
- DOSAGE SECTION	PS	1.0	0.0	0.0	1.0		420.7			0			0.0	0.0	420.7	SEE SEPARATE ESTIMATE
SEMI-SYNTHETICS	PS	1.0	0.0	0.0	1.0		791.3			0			0.0	0.0	791.3	SEE SEPARATE ESTIMATE
SUB TOTAL IN ADDITION TO FLOWSHEETS							5,423.8			0			0.0	0.0	5,423.8	
ALLOW - CIF/SHIPPING	10%						1,096.1			0			0.0	0.0	1,096.1	
TOTAL EQUIPMENT PROCUREMENT							12,056.9			0			0.0	0.0	12,056.9	

COALBREEZE LIMITED for

MANDERSTAM CONSULTING SERVICES

OPTION 1 FULL PROCESS

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILLIN G - UNIDO - PHILLIPINES

DATE Jan 97
SHEET 5 of 6
PRIME CASE A i.e. FILIPINO BUILD

DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB-CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB-CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
BULK MATERIAL PROCUREMENT																
PIPING	LOT	1.0	0.0	0.0	1.0		1,644.1	1.0		0			0.0	0.0	1,644.1	
ELECTRICAL	LOT	1.0	0.0	0.0	1.0		1,098.1	1.0		0			0.0	0.0	1,098.1	
INSTRUMENTATION	LOT	1.0	0.0	0.0	1.0		2,740.2	1.0		0			0.0	0.0	2,740.2	
COMMISSIONING SPARES	LOT	1.0	0.0	0.0	1.0		248.6	1.0		0			0.0	0.0	248.6	
SUB TOTAL BULK MATERIALS							5,727.0			0			0.0	0.0	5,727.0	
ALLOW CIF/SHIPPING	5%						286.4			0			0.0	0.0	286.4	
TOTAL BULK MATERIAL PROCUREMENT							6,013.4			0			0.0	0.0	6,013.4	
CONSTRUCTION & SUB CONTRACTS																
MECHANICAL ERECTION	LOT	1.0	0.0	0.0	1.0		0.0	1.0		38,112	25.0		952.8	0.0	952.8	
PIPING FABRICATE/ERECTION	LOT	1.0	0.0	0.0	1.0		0.0	1.0		91,468	25.0		2,286.7	0.0	2,286.7	
STEEL SUPPLY/FABRICATE/ERECTION	LOT	1.0	0.0	0.0	1.0		274.4	1.0		27,441	25.0		686.0	0.0	960.4	
E & I INSTALLATION	LOT	1.0	0.0	0.0	1.0		0.0	1.0		93,374	25.0		2,334.3	0.0	2,334.3	
F & G SUPPLY/ERECTION	LOT	1.0	0.0	0.0	1.0		182.9	1.0		4,573	25.0		114.3	0.0	297.3	
INSULATION SUB-CONTRACT	LOT	1.0	0.0	0.0	1.0		0.0	1.0		0		368,480	0.0	368.5	368.5	
PAINTING SUB CONTRACT	LOT	1.0	0.0	0.0	1.0		0.0	1.0		0		87,850	0.0	87.9	87.9	
CONTROL SYSTEM SUB-CONTRACT	LOT	1.0	0.0	0.0	1.0		0.0	1.0		0		2,052,400	0.0	2,052.4	2,052.4	
SITE ESTABLISHMENT/ENABLING WORK	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		250,000	0.0	250.0	250.0	DEPENDANT ON SITE
CIVILS SUB-CONTRACT	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		368,480	0.0	368.5	368.5	DEPENDANT ON SITE
PILING SUB-CONTACT	EA	2,000.0	0.0	0.0	2,000.0		0.0	2,000.0		0		510	0.0	1,020.0	1,020.0	DEPENDANT ON SITE
BUILDINGS SUB-CONTRACT	M2	3,375.0	0.0	0.0	3,375.0		0.0	3,375.0		0		1,087	0.0	3,668.6	3,668.6	SEE SEPARATE ESTIMATE
SCAFFOLDING SUB-CONTRACT	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		245,000	0.0	245.0	245.0	
CRANE HIRE	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		125,000	0.0	125.0	125.0	
PRECOMMISSIONING	LOT	1.0	0.0	0.0	1.0		0.0	1.0		6,374	25.0		159.4	0.0	159.4	
TOTAL CONSTRUCTION & SUB-CONTRACTS							457.3			261,342			6,533.6	8,182.1	15,173.0	
MINOR SUPPORT CONTRACTS																
VENDOR REPRESENTATIVES	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		120,000	0.0	120.0	120.0	
PROCESS LICENSES	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		553,700	0.0	553.7	553.7	10% x PROCESS EQUIPMENT
ENG SUPPORT DURING CONSTN	PS	1.0	0.0	0.0	1.0		0.0	1.0		6,000	90.0		540.0	0.0	540.0	
CONSULTANTS & STUDIES	PS	1.0	0.0	0.0	1.0		0.0	1.0		2,000	165.0		330.0	0.0	330.0	
TOTAL MINOR SUPPORT CONTRACTS							0.0			8,000			870.0	673.7	1,543.7	

COAL BREEZE LIMITED for

HANDERSTAM CONSULTING SERVICES

ORDER OF MAGNITUDE COST ESTIMATE for PENICILLIN G - UNIDO - PHILIPINES

DATE Jan [illegible]

SHEET [illegible]

PRIME CASE A i.e. FILIPINO BUILD

OPTION 1 FULL PROCESS

DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB-CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB-CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
MAJOR SUPPORT CONTRACTS																
CONCEPTUAL ENGINEERING	HRS	1.0	0.0	0.0	1.0		0.0	1.0		13,200	71.5		943.8	0.0	943.8	
DETAIL ENGINEERING - NATIONALS	HRS	1.0	0.0	0.0	1.0		0.0	1.0		0	30.0		0.0	0.0	0.0	
DETAIL ENGINEERING - EXPATS	HRS	0.0	0.0	0.0	0.0		0.0	0.0		132,000	66.0		8,712.0	0.0	8,712.0	
CONSTRUCTION SUPVN - NATIONALS	HRS	1.0	0.0	0.0	1.0		0.0	1.0		3,840	30.0		115.2	0.0	115.2	
CONSTRUCTION SUPVN - EXPATS	HRS	0.0	0.0	0.0	0.0		0.0	0.0		31,680	72.0		2,281.0	0.0	2,281.0	
COMMISSIONING - NATIONALS	HRS	1.0	0.0	0.0	1.0		0.0	1.0		3,120	72.0		224.6	0.0	224.6	4 MEN x 3MTHS @ 260HRS/MTH
COMMISSIONING - EXPATS	HRS	0.0	0.0	0.0	0.0		0.0	0.0		312	30.0		9.4	0.0	9.4	
COMMISSIONING - TRADES	HRS	1.0	0.0	0.0	1.0		0.0	1.0		11,700	30.0		351.0	0.0	351.0	15 MEN x 3MTHS @ 260HRS/MTH
TOTAL MAJOR SUPPORT CONTRACTS							0.0			195,852			12,637.0	0.0	12,637.0	
TOTAL EQUIPMENT PROCUREMENT							12,056.9			0			0.0	0.0	12,056.9	
TOTAL BULK MATERIAL PROCUREMENT							6,013.4			0			0.0	0.0	6,013.4	
TOTAL CONSTRUCTION & SUB-CONTRACTS							457.3			261,342			6,533.6	8,182.1	15,173.0	
TOTAL MINOR SUPPORT CONTRACTS							0.0			8,000			670.0	873.7	1,543.7	
TOTAL MAJOR SUPPORT CONTRACTS							0.0			195,852			12,637.0	0.0	12,637.0	
TOTAL COST ESTIMATE - EXCL CONTINGENCIES & ESCALATION							18,527.7			465,194			20,040.5	8,855.8	47,423.9	

COALBREEZE LIMITED for

MANDERSTAM CONSULTING SERVICES

OPTION 2 – NO PENICILLIN

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILLIN G – UNIDO – PHILLIPINES

DATE Feb. 92
SHEET 1 of 8
PRIME CASE i.e. FILIPINO BUILD

	DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB-CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB-CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
	EQUIPMENT PROCUREMENT																
	MEDIA PREPARATION																
MP1	CORN STEEP LIQUOR RECEPTION TANK	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
MP2	CORN STEEP LIQUOR TRANSFER PUMP	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
MP3	BAG OPENING MACHINE	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
MP4	WEIGHING HOPPER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
MP5	MEDIA MAKE UP TANK	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
MP6	MEDIA DELIVERY PUMP	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
MP7	MEDIA STERILISATION PLANT	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
MP8	DRUM EMPTYING PUMP	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	WEIGHBRIDGE	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	SPIRAL HEATER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	INCLUDED IN MP7
	SPIRAL INTERCHANGER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	INCLUDED IN MP7
	SPIRAL COOLER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	INCLUDED IN MP7
	HOLDING TUBE	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	INCLUDED IN MP7
	BALANCE TANK	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	SUB TOTAL – MEDIA PREPARATION							0.0			0			0.0	0.0	0.0	
	ADDITIVE PREPARATION																
AP1	SUGAR STERILISER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
AP2	PHENYL ACETATE STERILISER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
AP3	AMMONIUM SULPHATE STERILISER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
AP4	SOYA BEAN OIL STERILISER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
AP5	CAUSTIC POTASH or SODA STERILISER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	AIR FILTER	EA	5.0	0.0	0.0	5.0	0	0.0	5.0		0			0.0	0.0	0.0	
	AIR PREFILTER	EA	5.0	0.0	0.0	5.0	0	0.0	5.0		0			0.0	0.0	0.0	
	STEAM COILS	EA	5.0	0.0	0.0	5.0	0	0.0	5.0		0			0.0	0.0	0.0	
	SUB TOTAL – ADDITIVE PREPARATION							0.0			0			0.0	0.0	0.0	
	PENICILLIN FERMENTATION																
PF1	FERMENTER	EA	3.0	0.0	0.0	3.0	0	0.0	3.0		0			0.0	0.0	0.0	
PF2	AGITATOR FOR ABOVE	EA	3.0	0.0	0.0	3.0	0	0.0	3.0		0			0.0	0.0	0.0	
PF3	AIR & STEAM STERILISER	EA	3.0	0.0	0.0	3.0	0	0.0	3.0		0			0.0	0.0	0.0	
PF4	SEED FERMENTER	EA	3.0	0.0	0.0	3.0	0	0.0	3.0		0			0.0	0.0	0.0	
PF5	AGITATOR FOR ABOVE	EA	3.0	0.0	0.0	3.0	0	0.0	3.0		0			0.0	0.0	0.0	
PF6	SEED FERMENTER AIR STERILISER	EA	3.0	0.0	0.0	3.0	0	0.0	3.0		0			0.0	0.0	0.0	
PF7	PILOT FERMENTER	EA	3.0	0.0	0.0	3.0	0	0.0	3.0		0			0.0	0.0	0.0	
	AGITATOR FOR ABOVE	EA	3.0	0.0	0.0	3.0	0	0.0	3.0		0			0.0	0.0	0.0	
PF9	CONTROL SCHEME	EA	1.0	0.0	0.0	1.0		0.0	1.0		0			0.0	0.0	0.0	INC IN CONTROL SYSTEM S/C
PF8	FERMENTER DISCHARGE PUMP	EA	3.0	0.0	0.0	3.0	0	0.0	3.0		0			0.0	0.0	0.0	
	AIR COMPRESSOR	EA	3.0	0.0	0.0	3.0	0	0.0	3.0		0			0.0	0.0	0.0	
	AIR FILTER	EA	[illegible]	0.0	0.0	[illegible]	0	0.0	[illegible]		0			0.0	0.0	0.0	
	AIR PREFILTER	EA	[illegible]	0.0	0.0	[illegible]	0	0.0	[illegible]		0			0.0	0.0	0.0	
	SUB TOTAL – PENICILLIN FERMENTATION							0.0			0			0.0	0.0	0.0	

COALBREEZE LIMITED for

MANDERSTAM CONSULTING SERVICES

OPTION 2 - NO PENICILLIN

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILLIN G - UNIDO - PHILLIPINES

DATE Feb 87
SHEET 2 of 6
PRIME CASE A i.e. FILIPINO BUILD

DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB-CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB-CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
EQUIPMENT PROCUREMENT contd																
DOWNSTREAM RECOVERY																
DR1 HARVEST VESSEL	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
DR2 AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
DR3 HARVEST VESSEL DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
DR4 PREFILTER TREATMENT VESSEL	EA	2.0	0.0	0.0	2.0	0	0.0	2.0		0			0.0	0.0	0.0	
AGITATOR FOR ABOVE	EA	2.0	0.0	0.0	2.0	0	0.0	2.0		0			0.0	0.0	0.0	
DR5 ROTARY VACUUM FILTER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
DR6 FILTERED BROTH SEPARATOR	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
DR7 FILTERED BROTH RECEIVER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
DR8 PRIMARY CENTRIFUGAL EXTRACTOR	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
DR9 PRIMARY EXTRACTOR FEED PUMP	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
DR10 FILTERED BROTH COOLER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
DR11 DE-EMULSIFIER VESSEL	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
DR12 DE-EMULSIFIER METERING PUMP	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
DR13 SPENT BROTH SURGE VESSEL	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
DR14 SULPHURIC ACID MAKE UP VESSEL	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	POLY-ETHELYENE
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
DR15 SULPHURIC ACID FEED PUMP	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
DR16 DILUTED CAUSTIC VESSEL	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	CARBON STEEL
DR17 BUTYL ACETATE FEED VESSEL	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
DR18 BUTYL ACETATE FEED PUMP	EA	2.0	0.0	0.0	2.0	0	0.0	2.0		0			0.0	0.0	0.0	
AIR FILTER	EA	2.0	0.0	0.0	2.0	0	0.0	2.0		0			0.0	0.0	0.0	
AIR PREFILTER	EA	2.0	0.0	0.0	2.0	0	0.0	2.0		0			0.0	0.0	0.0	
ADDITIVE VESSEL	EA	2.0	0.0	0.0	2.0	0	0.0	2.0		0			0.0	0.0	0.0	
AGITATOR FOR ABOVE	EA	2.0	0.0	0.0	2.0	0	0.0	2.0		0			0.0	0.0	0.0	
K/O DRUM	EA	2.0	0.0	0.0	2.0	0	0.0	2.0		0			0.0	0.0	0.0	
VACUUM PUMP	EA	2.0	0.0	0.0	2.0	0	0.0	2.0		0			0.0	0.0	0.0	
MYCELIUM DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
FILTERED BROTH DISCHARGE PUMP	EA	2.0	0.0	0.0	2.0	0	0.0	2.0		0			0.0	0.0	0.0	
SPENT BROTH DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
BUTYL ACETATE COOLER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
BUTYL ACETATE FILTER	EA	2.0	0.0	0.0	2.0	0	0.0	2.0		0			0.0	0.0	0.0	
WASHING WATER FILTER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
SUB TOTAL - DOWNSTREAM RECOVERY							0.0			0			0.0	0.0	0.0	

COALBREEZE LIMITED for

MANDERSTAM CONSULTING SERVICES

OPTION 2 - NO PENICILIN

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILIN G - UNIDO - PHILIPPINES

DATE Feb 92
SHEET 3 OF 6
PRIME CASE A I e FILIPINO

	DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB-CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB-CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
	EQUIPMENT PROCUREMENT contd																
	PENICILIN PURIFICATION																
PP1	SPENT BUTYL ACETATE VESSEL	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
PP2	RICH BUTYL ACETATE VESSEL	EA	2.0	0.0	0.0	2.0	0	0.0	2.0		0			0.0	0.0	0.0	
	AGITATOR FOR ABOVE	EA	2.0	0.0	0.0	2.0	0	0.0	2.0		0			0.0	0.0	0.0	
PP3	BUFFER MAKE UP VESSEL	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
PP4	BUTYL ACETATE & BUFFER SURGE VES	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
PP5	BUTYL ACETATE & BUFFER FEED PUMP	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
PP6	SECOND'Y CENTRIFUGAL EXTRACTOR	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	SECONDARY EXTRACTOR FEED PUMP	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
PP7	RICH PENICILIN SURGE VESSEL	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
PP8	RICH PENICILIN DILUTION VESSEL	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
PP9	BUTANOL SUPPLY VESSEL	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
PP10	PENICILIN CRYSTALISER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
PP11	PENICILIN CRYSTALISER SLURRY VES	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
PP12	PENICILIN FILTER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
PP13	PENICILIN DRYER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
PP14	RICH BUTYL ACETATE FILTER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
PP15	BUFFER SOLUTION FEED PUMP	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	BUTYL ACETATE RECOVERY PUMP	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	CARBON FEED HOPPER	EA	2.0	0.0	0.0	2.0	0	0.0	2.0		0			0.0	0.0	0.0	
	CARBON FEED SCREW CONVEYOR	EA	2.0	0.0	0.0	2.0	0	0.0	2.0		0			0.0	0.0	0.0	
	RICH BUTYL ACETATE FEED PUMP	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	FILTERED BROTH DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	BUTYL ACETATE & BUFFER CONTACT R	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	SEPARATOR VESSEL	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	pH METER SURGE VESSEL	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	RICH PENICILIN FEED PUMP 4M3/HR	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	RICH PENICILIN FEED PUMP 8M3/HR	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	BUTANOL FILTER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	PENICILIN SOLUTION FILTER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	VACUUM SYSTEM	EA	2.0	0.0	0.0	2.0	0	0.0	2.0		0			0.0	0.0	0.0	
	BUTANOL VESSEL	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	SOLVENT CONDENSER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	SPENT SOLUTION CONDENSER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	SPENT SOLUTION PRECONDENSER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	OVERHEAD ACCUMULATOR	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	SPENT SOLVENT SURGE VESSEL	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	SPENT SOLVENT DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	DISTILLATE COOLER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	DISTILLATE FEED PUMP	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	WEIGHER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	
	SUB TOTAL - PENICILIN PURIFICATION							0.0			0			0.0	0.0	0.0	

COALBREEZE LIMITED for

MANDERSTAM CONSULTING SERVICES

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILLIN G – UNIDO – PHILLIPINES

DATE Feb '92
SHEET 4 of 4
PRIME CASE A to FILE

OPTION 2 – NO PENICILLIN

DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB-CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
EQUIPMENT PROCUREMENT contd																
6 APA PLANT																
APA1 PENICILLIN MAKE UP TANK	EA	1.0	0.0	0.0	1.0	17,500	17.5	1.0		0			0.0	0.0	17.5	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	8,750	8.7	1.0		0			0.0	0.0	8.7	
APA2 SCREW FEEDER	EA	1.0	0.0	0.0	1.0	4,200	4.2	1.0		0			0.0	0.0	4.2	
APA3 PENICILLIN DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	47,600	47.6	1.0		0			0.0	0.0	47.6	
APA4 ENZYME REACTOR	EA	1.0	0.0	0.0	1.0	28,000	28.0	1.0		0			0.0	0.0	28.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	14,000	14.0	1.0		0			0.0	0.0	14.0	
APA5 ENZYME RECOVERY FILTER	EA	1.0	0.0	0.0	1.0	17,500	17.5	1.0		0			0.0	0.0	17.5	
APA6 ENZYME RECOVERY FEED PUMP	EA	1.0	0.0	0.0	1.0	14,350	14.4	1.0		0			0.0	0.0	14.4	
APA7 EVAPORATOR FEED TANK	EA	1.0	0.0	0.0	1.0	10,710	10.7	1.0		0			0.0	0.0	10.7	
APA8 CRYSTALISER FEED PUMP (GEAR)	EA	1.0	0.0	0.0	1.0	3,500	3.5	1.0		0			0.0	0.0	3.5	
APA9 CRYSTALISER	EA	2.0	0.0	0.0	2.0	10,500	21.0	2.0		0			0.0	0.0	21.0	
AGITATOR FOR ABOVE	EA	2.0	0.0	0.0	2.0	5,250	10.5	2.0		0			0.0	0.0	10.5	
APA10 BELT FILTER/WASHER	EA	1.0	0.0	0.0	1.0	7,140	7.1	1.0		0			0.0	0.0	7.1	
APA11 FLUID BED DRYER	EA	1.0	0.0	0.0	1.0	63,000	63.0	1.0		0			0.0	0.0	63.0	
APA12 EVAPORATOR	EA	1.0	0.0	0.0	1.0	24,500	24.5	1.0		0			0.0	0.0	24.5	
APA13 EVAPORATOR FEED PUMP	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
SUB TOTAL – 6 APA PLANT							299.2			0			0.0	0.0	299.2	
EQUIPMENT PROCUREMENT SUMMARY																
SUB TOTAL – MEDIA PREPARATION							0.0			0			0.0	0.0	0.0	FROM SHEET 1
SUB TOTAL – ADDITIVE PREPARATION							0.0			0			0.0	0.0	0.0	FROM SHEET 1
SUB TOTAL – PENICILLIN FERMENTATION							0.0			0			0.0	0.0	0.0	FROM SHEET 1
SUB TOTAL – DOWNSTREAM RECOVERY							0.0			0			0.0	0.0	0.0	FROM SHEET 2
SUB TOTAL – PENICILLIN PURIFICATION							0.0			0			0.0	0.0	0.0	FROM SHEET 3
SUB TOTAL – 6 APA PLANT							299.2			0			0.0	0.0	299.2	FROM SHEET 4 (THIS SHEET)
SUB TOTAL FLOWSHEET BASED							299.2			0			0.0	0.0	299.2	
ALLOW – MISC MECHANICAL HANDLING	PS	1.0	0.0	0.0	1.0	35,000	35.0	1.0		0			0.0	0.0	35.0	MISC HOISTS/GANTRIES etc
– UTILITIES	PS	1.0	0.0	0.0	1.0	973,800	973.8	1.0		0			0.0	0.0	973.8	SEE SEPARATE ESTIMATE
ALLOW – POWER GENERATION	PS	1.0	0.0	0.0	1.0	INC	0.0	1.0		0			0.0	0.0	0.0	INC IN UTILITIES
ALLOW – DUST EXTRACTION	PS	1.0	0.0	0.0	1.0	INC	0.0	1.0		0			0.0	0.0	0.0	INC IN DOSAGE
ALLOW – CONDITIONING SYSTEMS	PS	1.0	0.0	0.0	1.0	INC	0.0	1.0		0			0.0	0.0	0.0	INC IN DOSAGE
ALLOW – BAGGING & PALLETISING	PS	1.0	0.0	0.0	1.0	INC	0.0	1.0		0			0.0	0.0	0.0	INC IN DOSAGE
– DOSAGE SECTION	PS	1.0	0.0	0.0	1.0		420.7			0			0.0	0.0	420.7	SEE SEPARATE ESTIMATE
– SEMI-SYNTHETICS	PS	1.0	0.0	0.0	1.0		781.4			0			0.0	0.0	781.4	SEE SEPARATE ESTIMATE
SUB TOTAL IN ADDITION TO FLOWSHEETS							2,220.9			0			0.0	0.0	2,220.9	
ALLOW – CIF/SHIPPING	10%						252.0			0			0.0	0.0	252.0	
TOTAL EQUIPMENT PROCUREMENT							2,772.2			0			0.0	0.0	2,772.2	

COALBREEZE LIMITED for

MANDERSTAM CONSULTING SERVICES

OPTION 2 - NO PENICILLIN

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILLIN G - UNIDO - PHILLIPINES

DATE Feb 97
SHEET 5 of 6
PRIME CASE A i.e. FILIPINO
BULK 0

DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INSTN MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB-CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB-CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
BULK MATERIAL PROCUREMENT																
PIPING	LOT	1.0	0.0	0.0	1.0		378.0	1.0		0			0.0	0.0	378.0	
ELECTRICAL	LOT	1.0	0.0	0.0	1.0		252.0	1.0		0			0.0	0.0	252.0	
INSTRUMENTATION	LOT	1.0	0.0	0.0	1.0		630.0	1.0		0			0.0	0.0	630.0	
COMMISSIONING SPARES	LOT	1.0	0.0	0.0	1.0		58.7	1.0		0			0.0	0.0	58.7	
SUB TOTAL BULK MATERIALS							1,318.8			0			0.0	0.0	1,318.8	
ALLOW - CIF/SHIPPING	5%						65.8			0			0.0	0.0	65.8	
TOTAL BULK MATERIAL PROCUREMENT							1,382.6			0			0.0	0.0	1,382.6	
CONSTRUCTION & SUB-CONTRACTS																
MECHANICAL ERECTION	LOT	1.0	0.0	0.0	1.0		0.0	1.0		5,747	25.0		143.7	0.0	143.7	
PIPING FABRICATE/ERECTION	LOT	1.0	0.0	0.0	1.0		0.0	1.0		13,793	25.0		344.8	0.0	344.8	
STEEL SUPPLY/FABRICATE/ERECTION	LOT	1.0	0.0	0.0	1.0		41.4	1.0		4,138	25.0		103.4	0.0	144.8	
E & I INSTALLATION	LOT	1.0	0.0	0.0	1.0		0.0	1.0		14,080	25.0		352.0	0.0	352.0	
F & G SUPPLY/ERECTION	LOT	1.0	0.0	0.0	1.0		27.6	1.0		690	25.0		17.2	0.0	44.8	
INSULATION SUB-CONTRACT	LOT	1.0	0.0	0.0	1.0		0.0	1.0		0		55,260	0.0	55.3	55.3	
PAINTING SUB-CONTRACT	LOT	1.0	0.0	0.0	1.0		0.0	1.0		0		13,260	0.0	13.3	13.3	
CONTROL SYSTEM SUB-CONTRACT	LOT	1.0	0.0	0.0	1.0		0.0	1.0		0		310,000	0.0	310.0	310.0	
SITE ESTABLISHMENT/ENABLING WORK	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		75,000	0.0	75.0	75.0	DEPENDANT ON SITE
CIVILS SUB-CONTRACT	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		55,260	0.0	55.3	55.3	DEPENDANT ON SITE
PILING SUB-CONTACT	EA	995.0	0.0	0.0	995.0		0.0	995.0		0		510	0.0	507.5	507.5	DEPENDANT ON SITE
BUILDINGS SUB-CONTRACT	M2	1,420.0	0.0	0.0	1,420.0		0.0	1,420.0		0		1,180	0.0	1,675.0	1,675.0	SEE SEPARATE ESTIMATE
SCAFFOLDING SUB-CONTRACT	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		36,810	0.0	36.8	36.8	
CRANE HIRE	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		50,000	0.0	50.0	50.0	
PRECOMMISSIONING	LOT	1.0	0.0	0.0	1.0		0.0	1.0		961	25.0		24.0	0.0	24.0	
TOTAL CONSTRUCTION & SUB-CONTRACTS							69.0			39,409			985.2	2,778.0	3,832.2	
MINOR SUPPORT CONTRACTS																
VENDOR REPRESENTATIVES	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		120,000	0.0	120.0	120.0	
PROCESS LICENSES	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		30,000	0.0	30.0	30.0	10% x PROCESS EQUIPMENT
ENG SUPPORT DURING CONSTN	PS	1.0	0.0	0.0	1.0		0.0	1.0		3,000	90.0		270.0	0.0	270.0	
CONSULTANTS & STUDIES	PS	1.0	0.0	0.0	1.0		0.0	1.0		1,000	165.0		165.0	0.0	165.0	
TOTAL MINOR SUPPORT CONTRACTS							0.0			4,000			435.0	150.0	585.0	

COALBREEZE LIMITED for
MANDERSTAM CONSULTING SERVICES

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILLIN G – UNIDO – PHILLIPINES

DATE Feb 87
SHEET 4 of 4
PRIME CASE A i.e. FILIPINO BUILD

OPTION 2 NO PENICILLIN

DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB-CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB-CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
MAJOR SUPPORT CONTRACTS																
CONCEPTUAL ENGINEERING	HRS	1.0	0.0	0.0	1.0		0.0	1.0		6,600	71.5		471.9	0.0	471.9	
DETAIL ENGINEERING – NATIONALS	HRS	1.0	0.0	0.0	1.0		0.0	1.0		0	30.0		0.0	0.0	0.0	
DETAIL ENGINEERING – EXPATS	HRS	0.0	0.0	0.0	0.0		0.0	0.0		66,000	66.0		4,356.0	0.0	4,356.0	
CONSTRUCTION SUPVN – NATIONALS	HRS	1.0	0.0	0.0	1.0		0.0	1.0		2,160	30.0		64.8	0.0	64.8	
CONSTRUCTION SUPVN – EXPATS	HRS	0.0	0.0	0.0	0.0		0.0	0.0		17,820	72.0		1,283.0	0.0	1,283.0	
COMMISSIONING – NATIONALS	HRS	1.0	0.0	0.0	1.0		0.0	1.0		2,080	72.0		149.8	0.0	149.8	4 MEN x 2MTHS @ 260HRS/MTH
COMMISSIONING – EXPATS	HRS	0.0	0.0	0.0	0.0		0.0	0.0		208	30.0		6.2	0.0	6.2	
COMMISSIONING – TRADES	HRS	1.0	0.0	0.0	1.0		0.0	1.0		7,800	30.0		234.0	0.0	234.0	15 MEN x 2MTHS @ 260HRS/MTH
TOTAL MAJOR SUPPORT CONTRACTS							0.0			102,668			6,565.7	0.0	6,565.7	
TOTAL EQUIPMENT PROCUREMENT							2,772.2			0			0.0	0.0	2,772.2	
TOTAL BULK MATERIAL PROCUREMENT							1,382.6			0			0.0	0.0	1,382.6	
TOTAL CONSTRUCTION & SUB-CONTRACTS							69.0			39,409			865.2	2,778.0	3,632.2	
TOTAL MINOR SUPPORT CONTRACTS							0.0			4,000			435.0	150.0	585.0	
TOTAL MAJOR SUPPORT CONTRACTS							0.0			102,668			6,565.7	0.0	6,565.7	
TOTAL COST ESTIMATE – EXCL CONTINGENCIES & ESCALATION							4,223.8			146,077			7,866.0	2,928.0	15,137.8	

COAL BREEZE LIMITED for

HANDERSTAM CONSULTING SERVICES

OPTION 3 NO DOSAGE & SEMI SYNTHETICS

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILLIN G - UNIDO - PHILIPPINES

DATE Jan 02
SHEET 1 of 6
PRIME CASE i.e. FILIPINO BUILD

	DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB-CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB-CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
	EQUIPMENT PROCUREMENT																
	MEDIA PREPARATION																
MP1	CORN STEEP LIQUOR RECEPTION TANK	EA	1.0	0.0	0.0	1.0	64,300	64.3	1.0		0			0.0	0.0	64.3	
MP2	CORN STEEP LIQUOR TRANSFER PUMP	EA	1.0	0.0	0.0	1.0	119,000	119.0	1.0		0			0.0	0.0	119.0	
MP3	BAG OPENING MACHINE	EA	1.0	0.0	0.0	1.0	24,500	24.5	1.0		0			0.0	0.0	24.5	
MP4	WEIGHING HOPPER	EA	1.0	0.0	0.0	1.0	8,750	8.8	1.0		0			0.0	0.0	8.8	
MP5	MEDIA MAKE UP TANK	EA	1.0	0.0	0.0	1.0	53,550	53.6	1.0		0			0.0	0.0	53.6	
MP6	MEDIA DELIVERY PUMP	EA	1.0	0.0	0.0	1.0	119,000	119.0	1.0		0			0.0	0.0	119.0	
MP7	MEDIA STERILISATION PLANT	EA	1.0	0.0	0.0	1.0	297,500	297.5	1.0		0			0.0	0.0	297.5	
MP8	DRUM EMPTYING PUMP	EA	1.0	0.0	0.0	1.0	4,900	4.9	1.0		0			0.0	0.0	4.9	
	WEIGHBRIDGE	EA	1.0	0.0	0.0	1.0	49,000	49.0	1.0		0			0.0	0.0	49.0	
	SPIRAL HEATER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	INCLUDED IN MP7
	SPIRAL INTERCHANGER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	INCLUDED IN MP7
	SPIRAL COOLER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	INCLUDED IN MP7
	HOLDING TUBE	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	INCLUDED IN MP7
	BALANCE TANK	EA	1.0	0.0	0.0	1.0	10,500	10.5	1.0		0			0.0	0.0	10.5	
	SUB TOTAL - MEDIA PREPARATION							751.0			0			0.0	0.0	751.0	
	ADDITIVE PREPARATION																
AP1	SUGAR STERILISER	EA	1.0	0.0	0.0	1.0	35,000	35.0	1.0		0			0.0	0.0	35.0	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	19,040	19.0	1.0		0			0.0	0.0	19.0	
AP2	PHENYL ACETATE STERILISER	EA	1.0	0.0	0.0	1.0	21,000	21.0	1.0		0			0.0	0.0	21.0	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	14,000	14.0	1.0		0			0.0	0.0	14.0	
AP3	AMMONIUM SULPHATE STERILISER	EA	1.0	0.0	0.0	1.0	35,000	35.0	1.0		0			0.0	0.0	35.0	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	19,040	19.0	1.0		0			0.0	0.0	19.0	
AP4	SOYA BEAN OIL STERILISER	EA	1.0	0.0	0.0	1.0	35,000	35.0	1.0		0			0.0	0.0	35.0	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	19,040	19.0	1.0		0			0.0	0.0	19.0	
AP5	CAUSTIC POTASH or SODA STERILISER	EA	1.0	0.0	0.0	1.0	35,000	35.0	1.0		0			0.0	0.0	35.0	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	19,040	19.0	1.0		0			0.0	0.0	19.0	
	AIR FILTER	EA	5.0	0.0	0.0	5.0	1,750	8.8	5.0		0			0.0	0.0	8.8	
	AIR PREFILTER	EA	5.0	0.0	0.0	5.0	1,190	6.0	5.0		0			0.0	0.0	6.0	
	STEAM COILS	EA	5.0	0.0	0.0	5.0	3,500	17.5	5.0		0			0.0	0.0	17.5	
	SUB TOTAL - ADDITIVE PREPARATION							283.4			0			0.0	0.0	283.4	
	PENICILLIN FERMENTATION																
PF1	FERMENTER	EA	3.0	0.0	0.0	3.0	140,000	420.0	3.0		0			0.0	0.0	420.0	
PF2	AGITATOR FOR ABOVE	EA	3.0	0.0	0.0	3.0	99,400	298.2	3.0		0			0.0	0.0	298.2	
PF3	AIR & STEAM STERILISER	EA	3.0	0.0	0.0	3.0	71,400	214.2	3.0		0			0.0	0.0	214.2	
PF4	SEED FERMENTER	EA	3.0	0.0	0.0	3.0	16,100	48.3	3.0		0			0.0	0.0	48.3	
PF5	AGITATOR FOR ABOVE	EA	3.0	0.0	0.0	3.0	19,040	57.1	3.0		0			0.0	0.0	57.1	
PF6	SEED FERMENTER AIR STERILISER	EA	3.0	0.0	0.0	3.0	7,210	21.6	3.0		0			0.0	0.0	21.6	
PF7	PILOT FERMENTER	EA	3.0	0.0	0.0	3.0	350,000	1,050.0	3.0		0			0.0	0.0	1,050.0	
	AGITATOR FOR ABOVE	EA	3.0	0.0	0.0	3.0	19,040	57.1	3.0		0			0.0	0.0	57.1	
PF8	CONTROL SCHEME	EA	1.0	0.0	0.0	1.0		0.0	1.0		0			0.0	0.0	0.0	INC IN CONTROL SYSTEM S/C
PF9	FERMENTER DISCHARGE PUMP	EA	3.0	0.0	0.0	3.0	120,400	361.2	3.0		0			0.0	0.0	361.2	
	AIR COMPRESSOR	EA	3.0	0.0	0.0	3.0	14,000	42.0	3.0		0			0.0	0.0	42.0	
	AIR FILTER	EA	9.0	0.0	0.0	9.0	1,750	15.8	9.0		0			0.0	0.0	15.8	
	AIR PREFILTER	EA	9.0	0.0	0.0	9.0	1,190	10.7	9.0		0			0.0	0.0	10.7	
	SUB TOTAL - PENICILLIN FERMENTATION							2,596.2			0			0.0	0.0	2,596.2	

COAL BREEZE LIMITED for
MANDERSTAM CONSULTING SERVICES

OPTION 3 NO DOSAGE & SEMI SYNTHETICS

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILLIN G - UNIDO - PHILIPPINES

DATE Jan 92
SHEET 2 of 8
PRIME CASE A i.e. FILIPINO BUILD

DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB-CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB-CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
EQUIPMENT PROCUREMENT contd ...																
DOWNSTREAM RECOVERY																
DR1 HARVEST VESSEL	EA	1.0	0.0	0.0	1.0	92,400	92.4	1.0		0			0.0	0.0	92.4	
DR2 AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	53,550	53.6	1.0		0			0.0	0.0	53.6	
DR3 HARVEST VESSEL DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	14,000	14.0	1.0		0			0.0	0.0	14.0	
DR4 PREFILTER TREATMENT VESSEL	EA	2.0	0.0	0.0	2.0	21,000	42.0	2.0		0			0.0	0.0	42.0	
AGITATOR FOR ABOVE	EA	2.0	0.0	0.0	2.0	10,500	21.0	2.0		0			0.0	0.0	21.0	
DR5 ROTARY VACUUM FILTER	EA	1.0	0.0	0.0	1.0	71,400	71.4	1.0		0			0.0	0.0	71.4	
DR6 FILTERED BROTH SEPARATOR	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
DR7 FILTERED BROTH RECEIVER	EA	1.0	0.0	0.0	1.0	33,600	33.6	1.0		0			0.0	0.0	33.6	
DR8 PRIMARY CENTRIFUGAL EXTRACTOR	EA	1.0	0.0	0.0	1.0	105,000	105.0	1.0		0			0.0	0.0	105.0	
DR9 PRIMARY EXTRACTOR FEED PUMP	EA	1.0	0.0	0.0	1.0	14,000	14.0	1.0		0			0.0	0.0	14.0	
DR10 FILTERED BROTH COOLER	EA	1.0	0.0	0.0	1.0	35,000	35.0	1.0		0			0.0	0.0	35.0	
DR11 DE EMULSIFIER VESSEL	EA	1.0	0.0	0.0	1.0	10,500	10.5	1.0		0			0.0	0.0	10.5	
DR12 DE EMULSIFIER METERING PUMP	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
DR13 SPENT BROTH SURGE VESSEL	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
DR14 SULPHURIC ACID MAKE UP VESSEL	EA	1.0	0.0	0.0	1.0	14,000	14.0	1.0		0			0.0	0.0	14.0	POLY ETHELYENE
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
DR15 SULPHURIC ACID FEED PUMP	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
DR16 DILUTED CAUSTIC VESSEL	EA	1.0	0.0	0.0	1.0	4,760	4.8	1.0		0			0.0	0.0	4.8	CARBON STEEL
DR17 BUTYL ACETATE FEED VESSEL	EA	1.0	0.0	0.0	1.0	11,200	11.2	1.0		0			0.0	0.0	11.2	
DR18 BUTYL ACETATE FEED PUMP	EA	2.0	0.0	0.0	2.0	7,140	14.3	2.0		0			0.0	0.0	14.3	
AIR FILTER	EA	2.0	0.0	0.0	2.0	1,750	3.5	2.0		0			0.0	0.0	3.5	
AIR PREFILTER	EA	2.0	0.0	0.0	2.0	1,190	2.4	2.0		0			0.0	0.0	2.4	
ADDITIVE VESSEL	EA	2.0	0.0	0.0	2.0	7,000	14.0	2.0		0			0.0	0.0	14.0	
AGITATOR FOR ABOVE	EA	2.0	0.0	0.0	2.0	3,500	7.0	2.0		0			0.0	0.0	7.0	
K/O DRUM	EA	2.0	0.0	0.0	2.0	7,000	14.0	2.0		0			0.0	0.0	14.0	
VACUUM PUMP	EA	2.0	0.0	0.0	2.0	4,760	9.5	2.0		0			0.0	0.0	9.5	
MYCELIUM DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	4,900	4.9	1.0		0			0.0	0.0	4.9	
FILTERED BROTH DISCHARGE PUMP	EA	2.0	0.0	0.0	2.0	4,900	9.8	2.0		0			0.0	0.0	9.8	
SPENT BROTH DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	4,900	4.9	1.0		0			0.0	0.0	4.9	
BUTYL ACETATE COOLER	EA	1.0	0.0	0.0	1.0	14,000	14.0	1.0		0			0.0	0.0	14.0	
BUTYL ACETATE FILTER	EA	2.0	0.0	0.0	2.0	1,750	3.5	2.0		0			0.0	0.0	3.5	
WASHING WATER FILTER	EA	1.0	0.0	0.0	1.0	1,190	1.2	1.0		0			0.0	0.0	1.2	
SUB TOTAL - DOWNSTREAM RECOVERY							860.4			0			0.0	0.0	860.4	

COAL BREEZE LIMITED for
HANDERSTAM CONSULTING SERVICES

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILLIN G - UNIDO - PHILLIPINES

DATE Jan 92
SHEET 3 of 8
PRIME CASE A I e FILIPINO BUILD

OPTION 3 NO DOSAGE & SEMI SYNTHETICS

	DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB-CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB-CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
	EQUIPMENT PROCUREMENT contd ...																
	PENICILLIN PURIFICATION																
PP1	SPENT BUTYL ACETATE VESSEL	EA	1.0	0.0	0.0	1.0	17,500	17.5	1.0		0			0.0	0.0	17.5	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	8,750	8.8	1.0		0			0.0	0.0	8.8	
PP2	RICH BUTYL ACETATE VESSEL	EA	2.0	0.0	0.0	2.0	14,000	28.0	2.0		0			0.0	0.0	28.0	
	AGITATOR FOR ABOVE	EA	2.0	0.0	0.0	2.0	7,000	14.0	2.0		0			0.0	0.0	14.0	
PP3	BUFFER MAKE UP VESSEL	EA	1.0	0.0	0.0	1.0	49,000	49.0	1.0		0			0.0	0.0	49.0	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	24,500	24.5	1.0		0			0.0	0.0	24.5	
PP4	BUTYL ACETATE & BUFFER SURGE VES	EA	1.0	0.0	0.0	1.0	22,400	22.4	1.0		0			0.0	0.0	22.4	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	11,200	11.2	1.0		0			0.0	0.0	11.2	
PP5	BUTYL ACETATE & BUFFER FEED PUMP	EA	1.0	0.0	0.0	1.0	14,350	14.3	1.0		0			0.0	0.0	14.3	
PP6	SECOND'Y CENTRIFUGAL EXTRACTOR	EA	1.0	0.0	0.0	1.0	28,000	28.0	1.0		0			0.0	0.0	28.0	
	SECONDARY EXTRACTOR FEED PUMP	EA	1.0	0.0	0.0	1.0	4,200	4.2	1.0		0			0.0	0.0	4.2	
PP7	RICH PENICILLIN SURGE VESSEL	EA	1.0	0.0	0.0	1.0	11,200	11.2	1.0		0			0.0	0.0	11.2	
PP8	RICH PENICILLIN DILUTION VESSEL	EA	1.0	0.0	0.0	1.0	17,500	17.5	1.0		0			0.0	0.0	17.5	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	8,750	8.8	1.0		0			0.0	0.0	8.8	
PP9	BUTANOL SUPPLY VESSEL	EA	1.0	0.0	0.0	1.0	11,200	11.2	1.0		0			0.0	0.0	11.2	
PP10	PENICILLIN CRYSTALISER	EA	1.0	0.0	0.0	1.0	17,500	17.5	1.0		0			0.0	0.0	17.5	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	8,750	8.8	1.0		0			0.0	0.0	8.8	
PP11	PENICILLIN CRYSTALISER SLURRY VES	EA	1.0	0.0	0.0	1.0	17,500	17.5	1.0		0			0.0	0.0	17.5	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	8,750	8.8	1.0		0			0.0	0.0	8.8	
PP12	PENICILLIN FILTER	EA	1.0	0.0	0.0	1.0	71,400	71.4	1.0		0			0.0	0.0	71.4	
PP13	PENICILLIN DRYER	EA	1.0	0.0	0.0	1.0	59,500	59.5	1.0		0			0.0	0.0	59.5	
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	29,750	29.7	1.0		0			0.0	0.0	29.7	
PP14	RICH BUTYL ACETATE FILTER	EA	1.0	0.0	0.0	1.0	24,500	24.5	1.0		0			0.0	0.0	24.5	
PP15	BUFFER SOLUTION FEED PUMP	EA	1.0	0.0	0.0	1.0	14,350	14.3	1.0		0			0.0	0.0	14.3	
	BUTYL ACETATE RECOVERY PUMP	EA	1.0	0.0	0.0	1.0	4,900	4.9	1.0		0			0.0	0.0	4.9	
	CARBON FEED HOPPER	EA	2.0	0.0	0.0	2.0	4,760	9.5	2.0		0			0.0	0.0	9.5	
	CARBON FEED SCREW CONVEYOR	EA	2.0	0.0	0.0	2.0	17,500	35.0	2.0		0			0.0	0.0	35.0	
	RICH BUTYL ACETATE FEED PUMP	EA	1.0	0.0	0.0	1.0	10,500	10.5	1.0		0			0.0	0.0	10.5	
	FILTERED BROTH DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	4,900	4.9	1.0		0			0.0	0.0	4.9	
	BUTYL ACETATE & BUFFER CONTACT R	EA	1.0	0.0	0.0	1.0	4,900	4.9	1.0		0			0.0	0.0	4.9	
	SEPARATOR VESSEL	EA	1.0	0.0	0.0	1.0	14,000	14.0	1.0		0			0.0	0.0	14.0	
	pH METER SURGE VESSEL	EA	1.0	0.0	0.0	1.0	1,400	1.4	1.0		0			0.0	0.0	1.4	
	RICH PENICILLIN FEED PUMP 4M3/HR	EA	1.0	0.0	0.0	1.0	4,900	4.9	1.0		0			0.0	0.0	4.9	
	RICH PENICILLIN FEED PUMP 8M3/HR	EA	1.0	0.0	0.0	1.0	8,400	8.4	1.0		0			0.0	0.0	8.4	
	BUTANOL FILTER	EA	1.0	0.0	0.0	1.0	3,500	3.5	1.0		0			0.0	0.0	3.5	
	PENICILLIN SOLUTION FILTER	EA	1.0	0.0	0.0	1.0	3,500	3.5	1.0		0			0.0	0.0	3.5	
	VACUUM SYSTEM	EA	2.0	0.0	0.0	2.0	119,000	238.0	2.0		0			0.0	0.0	238.0	
	BUTANOL VESSEL	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
	SOLVENT CONDENSER	EA	1.0	0.0	0.0	1.0	10,500	10.5	1.0		0			0.0	0.0	10.5	
	SPENT SOLUTION CONDENSER	EA	1.0	0.0	0.0	1.0	10,500	10.5	1.0		0			0.0	0.0	10.5	
	SPENT SOLUTION PRECONDENSER	EA	1.0	0.0	0.0	1.0	14,000	14.0	1.0		0			0.0	0.0	14.0	
	OVERHEAD ACCUMULATOR	EA	1.0	0.0	0.0	1.0	10,500	10.5	1.0		0			0.0	0.0	10.5	
	SPENT SOLVENT SURGE VESSEL	EA	1.0	0.0	0.0	1.0	10,500	10.5	1.0		0			0.0	0.0	10.5	
	SPENT SOLVENT DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	4,900	4.9	1.0		0			0.0	0.0	4.9	
	DISTILLATE COOLER	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
	DISTILLATE FEED PUMP	EA	1.0	0.0	0.0	1.0	4,900	4.9	1.0		0			0.0	0.0	4.9	
	WEIGHER	EA	1.0	0.0	0.0	1.0	1,050	1.1	1.0		0			0.0	0.0	1.1	
	SUB TOTAL - PENICILLIN PURIFICATION							946.8			0			0.0	0.0	946.8	

COALBREEZE LIMITED for

MANDERSTAM CONSULTING SERVICES

OPTION 3 NO DOSAGE & SEMI SYNTHETICS

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILIN G - UNIDO - PHILLIPINES

DATE Jan 92
SHEET 4 OF 6
PRIME CASE 1 i.e. FILIPINO BUILD

DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB-CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
EQUIPMENT PROCUREMENT contd																
6 APA PLANT																
APA1 PENICILIN MAKE UP TANK	EA	1.0	0.0	0.0	1.0	17,500	17.5	1.0		0			0.0	0.0	17.5	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	8,750	8.8	1.0		0			0.0	0.0	8.8	
APA2 SCREW FEEDER	EA	1.0	0.0	0.0	1.0	4,200	4.2	1.0		0			0.0	0.0	4.2	
APA3 PENICILIN DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	47,600	47.6	1.0		0			0.0	0.0	47.6	
APA4 ENZYME REACTOR	EA	1.0	0.0	0.0	1.0	28,000	28.0	1.0		0			0.0	0.0	28.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	14,000	14.0	1.0		0			0.0	0.0	14.0	
APA5 ENZYME RECOVERY FILTER	EA	1.0	0.0	0.0	1.0	17,500	17.5	1.0		0			0.0	0.0	17.5	
APA6 ENZYME RECOVERY FEED PUMP	EA	1.0	0.0	0.0	1.0	14,350	14.3	1.0		0			0.0	0.0	14.3	
APA7 EVAPORATOR FEED TANK	EA	1.0	0.0	0.0	1.0	10,710	10.7	1.0		0			0.0	0.0	10.7	
APA8 CRYSTALISER FEED PUMP (GEAR)	EA	1.0	0.0	0.0	1.0	3,500	3.5	1.0		0			0.0	0.0	3.5	
APA9 CRYSTALISER	EA	2.0	0.0	0.0	2.0	10,500	21.0	2.0		0			0.0	0.0	21.0	
AGITATOR FOR ABOVE	EA	2.0	0.0	0.0	[illegible]	5,250	10.5	2.0		0			0.0	0.0	10.5	
APA10 BELT FILTER/WASHER	EA	1.0	0.0	0.0	1.0	7,140	7.1	1.0		0			0.0	0.0	7.1	
APA11 FLUID BED DRYER	EA	1.0	0.0	0.0	1.0	63,000	63.0	1.0		0			0.0	0.0	63.0	
APA12 EVAPORATOR	EA	1.0	0.0	0.0	1.0	24,500	24.5	1.0		0			0.0	0.0	24.5	
APA13 EVAPORATOR FEED PUMP	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
SUB TOTAL 6 APA PLANT							299.3			0			0.0	0.0	299.3	
EQUIPMENT PROCUREMENT SUMMARY																
SUB TOTAL - MEDIA PREPARATION							751.0			0			0.0	0.0	751.0	FROM SHEET 1
SUB TOTAL - ADDITIVE PREPARATION							283.4			0			0.0	0.0	283.4	FROM SHEET 1
SUB TOTAL - PENICILIN FERMENTATION							2,598.2			0			0.0	0.0	2,598.2	FROM SHEET 1
SUB TOTAL - DOWNSTREAM RECOVERY							660.4			0			0.0	0.0	660.4	FROM SHEET 2
SUB TOTAL - PENICILIN PURIFICATION							946.8			0			0.0	0.0	946.8	FROM SHEET 3
SUB TOTAL - 6 APA PLANT							299.3			0			0.0	0.0	299.3	FROM SHEET 4 (THIS SHEET)
SUB TOTAL FLOWSHEET BASED							5,537.0			0			0.0	0.0	5,537.0	
ALLOW - MISC MECHANICAL HANDLING	PS	1.0	0.0	0.0	1.0	70,000	70.0	1.0		0			0.0	0.0	70.0	MISC HOISTS/GANTRIES etc
UTILITIES	PS	1.0	0.0	0.0	1.0	4,141,800	4,141.8	1.0		0			0.0	0.0	4,141.8	SEE SEPARATE ESTIMATE
ALLOW - POWER GENERATION	PS	1.0	0.0	0.0	1.0	INC	0.0	1.0		0			0.0	0.0	0.0	INC IN UTILITIES
ALLOW - DUST EXTRACTION	PS	1.0	0.0	0.0	1.0	N/R	0.0	1.0		0			0.0	0.0	0.0	NOT REQUIRED
ALLOW - CONDITIONING SYSTEMS	PS	1.0	0.0	0.0	1.0	N/R	0.0	1.0		0			0.0	0.0	0.0	NOT REQUIRED
ALLOW - BAGGING & PALLETISING	PS	1.0	0.0	0.0	1.0	N/R	0.0	1.0		0			0.0	0.0	0.0	NOT REQUIRED
DOSAGE SECTION	PS	1.0	0.0	0.0	1.0	N/R	0.0			0			0.0	0.0	0.0	NOT REQUIRED
SEMI SYNTHETICS	PS	1.0	0.0	0.0	1.0	N/R	0.0			0			0.0	0.0	0.0	NOT REQUIRED
SUB TOTAL IN ADDITION TO FLOWSHEETS							4,211.8			0			0.0	0.0	4,211.8	
ALLOW - CIF/SHIPPING	10%						974.9			0			0.0	0.0	974.9	
TOTAL EQUIPMENT PROCUREMENT							10,723.7			0			0.0	0.0	10,723.7	

CLAL BREEZE LIMITED for

MANDERSTAM CONSULTING SERVICES

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILLIN G - UNIDO - PHILIPPINES

DATE Jan 97
SHEET 5 of 6
PRIME CASE A i.e. FILIPINO BUILD

OPTION 3 NO DOSAGE & SEMI SYNTHETICS

DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB-CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
BULK MATERIAL PROCUREMENT																
PIPING	LOT	1.0	0.0	0.0	1.0		1,462.3	1.0		0			0.0	0.0	1,462.3	
ELECTRICAL	LOT	1.0	0.0	0.0	1.0		874.9	1.0		0			0.0	0.0	874.9	
INSTRUMENTATION	LOT	1.0	0.0	0.0	1.0		2,437.2	1.0		0			0.0	0.0	2,437.2	
COMMISSIONING SPARES	LOT	1.0	0[illegible]	0.0	1.0		219.3	1[illegible]		0			0.0	0.0	219.3	
SUB TOTAL BULK MATERIALS							5,093.7			0			0.0	0.0	5,093.7	
ALLOW CIF/SHIPPING	5%						254.7			0			0.0	0.0	254.7	
TOTAL BULK MATERIAL PROCUREMENT							5,348.4			0			0.0	0.0	5,348.4	
CONSTRUCTION & SUB-CONTRACTS																
MECHANICAL ERECTION	LOT	1.0	0.0	0.0	1.0		0.0	1.0		33,610	25.0		840.2	0.0	840.2	
PIPING FABRICATE/ERECTION	LOT	1.0	0.0	0.0	1.0		0.0	1.0		80,664	25.0		2,016.6	0.0	2,016.6	
STEEL SUPPLY/FABRICATE/ERECTION	LOT	1.0	0.0	0.0	1.0		242.0	1.0		24,199	25.0		605.0	0.0	847.0	
E & I INSTALLATION	LOT	1.0	0.0	0.0	1.0		0.0	1.0		82,344	25.0		2,058.6	0.0	2,058.6	
F & G SUPPLY/ERECTION	LOT	1.0	0.0	0.0	1.0		161.3	1.0		4,033	25.0		100.8	0.0	262.2	
INSULATION SUB-CONTRACT	LOT	1.0	0.0	0.0	1.0		0.0	1.0		0		323,200	0.0	323.2	323.2	
PAINTING SUB-CONTRACT	LOT	1.0	0.0	0.0	1.0		0.0	1.0		0		78,000	0.0	78.0	78.0	
CONTROL SYSTEM SUB-CONTRACT	LOT	1.0	0.0	0.0	1.0		0.0	1.0		0		1,810,000	0.0	1,810.0	1,810.0	
SITE ESTABLISHMENT/ENABLING WORK	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		250,000	0.0	250.0	250.0	DEPENDANT ON SITE
CIVILS SUB-CONTRACT	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		323,200	0.0	323.2	323.2	DEPENDANT ON SITE
PILING SUB CONTACT	EA	2,000.0	0.0	0.0	2,000.0		0.0	2,000.0		0		510	0.0	1,020.0	1,020.0	DEPENDANT ON SITE
BUILDINGS SUB-CONTRACT	M2	3,150.0	0.0	0.0	3,150.0		0.0	3,150.0		0		1,075	0.0	3,387.5	3,387.5	SEE SEPARATE ESTIMATE
SCAFFOLDING SUB CONTRACT	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		218,000	0.0	218.0	218.0	
CRANE HIRE	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		125,000	0.0	125.0	125.0	
PRECOMMISSIONING	LOT	1.0	0.0	0.0	1.0		0.0	1.0		5,621	25.0		140.5	0.0	140.5	
TOTAL CONSTRUCTION & SUB-CONTRACTS							403.3			230,472			5,761.8	7,532.9	13,698.0	
MINOR SUPPORT CONTRACTS																
VENDOR REPRESENTATIVES	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		120,000	0.0	120.0	120.0	
PROCESS LICENSES	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		554,075	0.0	554.1	554.1	10% x PROCESS EQUIPMENT
ENG SUPPORT DURING CONSTN	PS	1.0	0.0	0.0	1.0		0.0	1.0		6,000	90.0		540.0	0.0	540.0	
CONSULTANTS & STUDIES	PS	1.0	0.0	0.0	1.0		0.0	1.0		2,000	165.0		330.0	0.0	330.0	
TOTAL MINOR SUPPORT CONTRACTS							0.0			8,000			870.0	674.1	1,544.1	

CATALBREEZE LIMITED for
HANDERSTAM CONSULTING SERVICES

OPTION 3 - NO DOSAGE & SEMI SYNTHETICS

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILLIN G - UNIDO - PHILIPPINES

DATE Jan 92
SHEET 6 of 6
PRIME CASE A i.e. FILIPINO BUILD

DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB-CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
MAJOR SUPPORT CONTRACTS																
CONCEPTUAL ENGINEERING	HRS	1.0	0.0	0.0	1.0		0.0	1.0		11,000	71.5		786.5	0.0	786.5	
DETAIL ENGINEERING - NATIONALS	HRS	1.0	0.0	0.0	1.0		0.0	1.0		0	30.0		0.0	0.0	0.0	
DETAIL ENGINEERING - EXPATS	HRS	0.0	0.0	0.0	0.0		0.0	0.0		110,000	66.0		7,260.0	0.0	7,260.0	
CONSTRUCTION SUPVN - NATIONALS	HRS	1.0	0.0	0.0	1.0		0.0	1.0		3,600	30.0		108.0	0.0	108.0	
CONSTRUCTION SUPVN - EXPATS	HRS	0.0	0.0	0.0	0.0		0.0	0.0		29,700	72.0		2,138.4	0.0	2,138.4	
COMMISSIONING - NATIONALS	HRS	1.0	0.0	0.0	1.0		0.0	1.0		3,120	72.0		224.6	0.0	224.6	4 MEN x 3MTHS @ 260HRS/MTH
COMMISSIONING - EXPATS	HRS	0.0	0.0	0.0	0.0		0.0	0.0		312	30.0		9.4	0.0	9.4	
COMMISSIONING - TRADES	HRS	1.0	0.0	0.0	1.0		0.0	1.0		11,700	30.0		351.0	0.0	351.0	15 MEN x 3MTHS @ 260HRS/MTH
TOTAL MAJOR SUPPORT CONTRACTS							0.0			169,432			10,877.9	0.0	10,877.9	
TOTAL EQUIPMENT PROCUREMENT							10,723.7			0			0.0	0.0	10,723.7	
TOTAL BULK MATERIAL PROCUREMENT							5,348.4			0			0.0	0.0	5,348.4	
TOTAL CONSTRUCTION & SUB-CONTRACTS							403.3			230,472			5,761.8	7,532.9	13,698.0	
TOTAL MINOR SUPPORT CONTRACTS							0.0			8,000			870.0	674.1	1,544.1	
TOTAL MAJOR SUPPORT CONTRACTS							0.0			169,432			10,877.9	0.0	10,877.9	
TOTAL COST ESTIMATE - EXCL CONTINGENCIES & ESCALATION							16,475.4			407,904			17,509.7	8,207.0	42,192.1	

[illegible] BREEZE LIMITED for
MANDERSTAM CONSULTING SERVICES

OPTION 1 FULL PROCESS

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILLIN G - UNIDO - PHILIPPINES

DATE Jan 8[illegible]
SHEET 1 of 8
BASE CASE I.e. WEST EUROPE BUILD

DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB-CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB-CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
EQUIPMENT PROCUREMENT																
MEDIA PREPARATION																
MP1 CORN STEEP LIQUOR RECEPTION TANK	EA	1.0	0.0	0.0	1.0	91,800	91.8	1.0		0			0.0	0.0	91.8	
MP2 CORN STEEP LIQUOR TRANSFER PUMP	EA	1.0	0.0	0.0	1.0	170,000	170.0	1.0		0			0.0	0.0	170.0	
MP3 BAG OPENING MACHINE	EA	1.0	0.0	0.0	1.0	35,000	35.0	1.0		0			0.0	0.0	35.0	
MP4 WEIGHING HOPPER	EA	1.0	0.0	0.0	1.0	12,500	12.5	1.0		0			0.0	0.0	12.5	
MP5 MEDIA MAKE UP TANK	EA	1.0	0.0	0.0	1.0	76,500	76.5	1.0		0			0.0	0.0	76.5	
MP6 MEDIA DELIVERY PUMP	EA	1.0	0.0	0.0	1.0	170,000	170.0	1.0		0			0.0	0.0	170.0	
MP7 MEDIA STERILISATION PLANT	EA	1.0	0.0	0.0	1.0	425,000	425.0	1.0		0			0.0	0.0	425.0	
MP8 DRUM EMPTYING PUMP	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
WEIGHBRIDGE	EA	1.0	0.0	0.0	1.0	70,000	70.0	1.0		0			0.0	0.0	70.0	
SPIRAL HEATER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	INCLUDED IN MP7
SPIRAL INTERCHANGER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	INCLUDED IN MP7
SPIRAL COOLER	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	INCLUDED IN MP7
HOLDING TUBE	EA	1.0	0.0	0.0	1.0	0	0.0	1.0		0			0.0	0.0	0.0	INCLUDED IN MP7
BALANCE TANK	EA	1.0	0.0	0.0	1.0	15,000	15.0	1.0		0			0.0	0.0	15.0	
SUB TOTAL MEDIA PREPARATION							1,072.8			0			0.0	0.0	1,072.8	
ADDITIVE PREPARATION																
AP1 SUGAR STERILISER	EA	1.0	0.0	0.0	1.0	50,000	50.0	1.0		0			0.0	0.0	50.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	27,200	27.2	1.0		0			0.0	0.0	27.2	
AP2 PHENYL ACETATE STERILISER	EA	1.0	0.0	0.0	1.0	30,000	30.0	1.0		0			0.0	0.0	30.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	20,000	20.0	1.0		0			0.0	0.0	20.0	
AP3 AMMONIUM SULPHATE STERILISER	EA	1.0	0.0	0.0	1.0	50,000	50.0	1.0		0			0.0	0.0	50.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	27,200	27.2	1.0		0			0.0	0.0	27.2	
AP4 SOYA BEAN OIL STERILISER	EA	1.0	0.0	0.0	1.0	50,000	50.0	1.0		0			0.0	0.0	50.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	27,200	27.2	1.0		0			0.0	0.0	27.2	
AP5 CAUSTIC POTASH or SODA STERILISER	EA	1.0	0.0	0.0	1.0	50,000	50.0	1.0		0			0.0	0.0	50.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	27,200	27.2	1.0		0			0.0	0.0	27.2	
AIR FILTER	EA	5.0	0.0	0.0	5.0	2,500	12.5	5.0		0			0.0	0.0	12.5	
AIR PREFILTER	EA	5.0	0.0	0.0	5.0	1,700	8.5	5.0		0			0.0	0.0	8.5	
STEAM COILS	EA	5.0	0.0	0.0	5.0	5,000	25.0	5.0		0			0.0	0.0	25.0	
SUB TOTAL - ADDITIVE PREPARATION							404.8			0			0.0	0.0	404.8	
PENICILLIN FERMENTATION																
PF1 FERMENTER	EA	3.0	0.0	0.0	3.0	200,000	600.0	3.0		0			0.0	0.0	600.0	
PF2 AGITATOR FOR ABOVE	EA	3.0	0.0	0.0	3.0	142,000	426.0	3.0		0			0.0	0.0	426.0	
PF3 AIR & STEAM STERILISER	EA	3.0	0.0	0.0	3.0	102,000	306.0	3.0		0			0.0	0.0	306.0	
PF4 SEED FERMENTER	EA	3.0	0.0	0.0	3.0	23,000	69.0	3.0		0			0.0	0.0	69.0	
PF5 AGITATOR FOR ABOVE	EA	3.0	0.0	0.0	3.0	27,200	81.6	3.0		0			0.0	0.0	81.6	
PF6 SEED FERMENTER AIR STERILISER	EA	3.0	0.0	0.0	3.0	10,300	30.9	3.0		0			0.0	0.0	30.9	
PF7 PILOT FERMENTER	EA	1.0	0.0	0.0	1.0	500,000	500.0	1.0		0			0.0	0.0	500.0	
AGITATOR FOR ABOVE	EA	3.0	0.0	0.0	3.0	27,200	81.6	3.0		0			0.0	0.0	81.6	
PF8 CONTROL SCHEME	EA	1.0	0.0	0.0	1.0		0.0	1.0		0			0.0	0.0	0.0	INC IN CONTROL SYSTEM S/C
PF9 FERMENTER DISCHARGE PUMP	EA	3.0	0.0	0.0	3.0	172,000	516.0	3.0		0			0.0	0.0	516.0	
AIR COMPRESSOR	EA	3.0	0.0	0.0	3.0	20,000	60.0	3.0		0			0.0	0.0	60.0	
AIR FILTER	EA	9.0	0.0	0.0	9.0	2,500	22.5	9.0		0			0.0	0.0	22.5	
AIR PREFILTER	EA	9.0	0.0	0.0	9.0	1,700	15.3	9.0		0			0.0	0.0	15.3	
SUB TOTAL - PENICILLIN FERMENTATION							2,708.9			0			0.0	0.0	2,708.9	

[illegible] BREEZE LIMITED for
MANDERSTAM CONSULTING SERVICES

OPTION 1 - FULL PROCESS

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILLIN G - UNIDO - PHILIPPINES

DATE Jan 92
SHEET 2 of n
BASE CASE I.e. WEST EUROPE BUILD

	DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
	EQUIPMENT PROCUREMENT contd...																
	DOWNSTREAM RECOVERY																
DH1	HARVEST VESSEL	EA	1.0	0.0	0.0	1.0	132,000	132.0	1.0		0			0.0	0.0	132.0	
DH2	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	78,500	78.5	1.0		0			0.0	0.0	78.5	
DH3	HARVEST VESSEL DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	20,000	20.0	1.0		0			0.0	0.0	20.0	
DH4	PREFILTER TREATMENT VESSEL	EA	2.0	0.0	0.0	2.0	30,000	60.0	2.0		0			0.0	0.0	60.0	
	AGITATOR FOR ABOVE	EA	2.0	0.0	0.0	2.0	15,000	30.0	2.0		0			0.0	0.0	30.0	
DH5	ROTARY VACUUM FILTER	EA	1.0	0.0	0.0	1.0	102,000	102.0	1.0		0			0.0	0.0	102.0	
DH6	FILTERED BROTH SEPARATOR	EA	1.0	0.0	0.0	1.0	10,000	10.0	1.0		0			0.0	0.0	10.0	
DH7	FILTERED BROTH RECEIVER	EA	1.0	0.0	0.0	1.0	48,000	48.0	1.0		0			0.0	0.0	48.0	
DH8	PRIMARY CENTRIFUGAL EXTRACTOR	EA	1.0	0.0	0.0	1.0	150,000	150.0	1.0		0			0.0	0.0	150.0	
DH9	PRIMARY EXTRACTOR FEED PUMP	EA	1.0	0.0	0.0	1.0	20,000	20.0	1.0		0			0.0	0.0	20.0	
DH10	FILTERED BROTH COOLER	EA	1.0	0.0	0.0	1.0	50,000	50.0	1.0		0			0.0	0.0	50.0	
DH11	DE EMULSIFIER VESSEL	EA	1.0	0.0	0.0	1.0	15,000	15.0	1.0		0			0.0	0.0	15.0	
DH12	DE EMULSIFIER METERING PUMP	EA	1.0	0.0	0.0	1.0	10,000	10.0	1.0		0			0.0	0.0	10.0	
DH13	SPENT BROTH SURGE VESSEL	EA	1.0	0.0	0.0	1.0	10,000	10.0	1.0		0			0.0	0.0	10.0	
DH14	SULPHURIC ACID MAKE UP VESSEL	EA	1.0	0.0	0.0	1.0	20,000	20.0	1.0		0			0.0	0.0	20.0	POLY ETHYLENE
	AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	10,000	10.0	1.0		0			0.0	0.0	10.0	
DH15	SULPHURIC ACID FEED PUMP	EA	1.0	0.0	0.0	1.0	10,000	10.0	1.0		0			0.0	0.0	10.0	
DH16	DILUTED CAUSTIC VESSEL	EA	1.0	0.0	0.0	1.0	8,800	8.8	1.0		0			0.0	0.0	8.8	CARBON STEEL
DH17	BUTYL ACETATE FEED VESSEL	EA	1.0	0.0	0.0	1.0	18,000	18.0	1.0		0			0.0	0.0	18.0	
DH18	BUTYL ACETATE FEED PUMP	EA	2.0	0.0	0.0	2.0	10,200	20.4	2.0		0			0.0	0.0	20.4	
	AIR FILTER	EA	2.0	0.0	0.0	2.0	2,500	5.0	2.0		0			0.0	0.0	5.0	
	AIR PREFILTER	EA	2.0	0.0	0.0	2.0	1,700	3.4	2.0		0			0.0	0.0	3.4	
	ADDITIVE VESSEL	EA	2.0	0.0	0.0	2.0	10,000	20.0	2.0		0			0.0	0.0	20.0	
	AGITATOR FOR ABOVE	EA	2.0	0.0	0.0	2.0	5,000	10.0	2.0		0			0.0	0.0	10.0	
	K/O DRUM	EA	2.0	0.0	0.0	2.0	10,000	20.0	2.0		0			0.0	0.0	20.0	
	VACUUM PUMP	EA	2.0	0.0	0.0	2.0	6,800	13.6	2.0		0			0.0	0.0	13.6	
	MYCELIUM DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
	FILTERED BROTH DISCHARGE PUMP	EA	2.0	0.0	0.0	2.0	7,000	14.0	2.0		0			0.0	0.0	14.0	
	SPENT BROTH DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
	BUTYL ACETATE COOLER	EA	1.0	0.0	0.0	1.0	20,000	20.0	1.0		0			0.0	0.0	20.0	
	BUTYL ACETATE FILTER	EA	2.0	0.0	0.0	2.0	2,500	5.0	2.0		0			0.0	0.0	5.0	
	WASHING WATER FILTER	EA	1.0	0.0	0.0	1.0	1,700	1.7	1.0		0			0.0	0.0	1.7	
	SUB TOTAL DOWNSTREAM RECOVERY							843.4			0			0.0	0.0	843.4	

CATALBREEZE LIMITED for

MANDERSTAM CONSULTING SERVICES

OPTION 1 FULL PROCESS

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILLIN G - UNIDO - PHILIPPINES

DATE Jan 92
SHEET 3 of 6
BASE CASE 1 - WEST EUROPE BUILD

DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
EQUIPMENT PROCUREMENT contd																
PENICILLIN PURIFICATION																
PP1 SPENT BUTYL ACETATE VESSEL	EA	1.0	0.0	0.0	1.0	25,000	25.0	1.0		0			0.0	0.0	25.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	12,500	12.5	1.0		0			0.0	0.0	12.5	
PP2 RICH BUTYL ACETATE VESSEL	EA	2.0	0.0	0.0	2.0	20,000	40.0	2.0		0			0.0	0.0	40.0	
AGITATOR FOR ABOVE	EA	2.0	0.0	0.0	2.0	10,000	20.0	2.0		0			0.0	0.0	20.0	
PP3 BUFFER MAKE UP VESSEL	EA	1.0	0.0	0.0	1.0	70,000	70.0	1.0		0			0.0	0.0	70.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	35,000	35.0	1.0		0			0.0	0.0	35.0	
PP4 BUTYL ACETATE & BUFFER SURGE VES	EA	1.0	0.0	0.0	1.0	32,000	32.0	1.0		0			0.0	0.0	32.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	16,000	16.0	1.0		0			0.0	0.0	16.0	
PP5 BUTYL ACETATE & BUFFER FEED PUMP	EA	1.0	0.0	0.0	1.0	20,500	20.5	1.0		0			0.0	0.0	20.5	
PP6 SECOND'Y CENTRIFUGAL EXTRACTOR	EA	1.0	0.0	0.0	1.0	40,000	40.0	1.0		0			0.0	0.0	40.0	
SECONDARY EXTRACTOR FEED PUMP	EA	1.0	0.0	0.0	1.0	6,000	6.0	1.0		0			0.0	0.0	6.0	
PP7 RICH PENICILLIN SURGE VESSEL	EA	1.0	0.0	0.0	1.0	16,000	16.0	1.0		0			0.0	0.0	16.0	
PP8 RICH PENICILLIN DILUTION VESSEL	EA	1.0	0.0	0.0	1.0	25,000	25.0	1.0		0			0.0	0.0	25.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	12,500	12.5	1.0		0			0.0	0.0	12.5	
PP9 BUTANOL SUPPLY VESSEL	EA	1.0	0.0	0.0	1.0	16,000	16.0	1.0		0			0.0	0.0	16.0	
PP10 PENICILLIN CRYSTALISER	EA	1.0	0.0	0.0	1.0	25,000	25.0	1.0		0			0.0	0.0	25.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	12,500	12.5	1.0		0			0.0	0.0	12.5	
PP11 PENICILLIN CRYSTALISER SLURRY VES	EA	1.0	0.0	0.0	1.0	25,000	25.0	1.0					0.0	0.0	25.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	12,500	12.5	1.0					0.0	0.0	12.5	
PP12 PENICILLIN FILTER	EA	1.0	0.0	0.0	1.0	102,000	102.0	1.0		0			0.0	0.0	102.0	
PP13 PENICILLIN DRYER	EA	1.0	0.0	0.0	1.0	85,000	85.0	1.0		0			0.0	0.0	85.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	42,500	42.5	1.0		0			0.0	0.0	42.5	
PP14 RICH BUTYL ACETATE FILTER	EA	1.0	0.0	0.0	1.0	35,000	35.0	1.0		0			0.0	0.0	35.0	
PP15 BUFFER SOLUTION FEED PUMP	EA	1.0	0.0	0.0	1.0	20,500	20.5	1.0		0			0.0	0.0	20.5	
BUTYL ACETATE RECOVERY PUMP	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
CARBON FEED HOPPER	EA	2.0	0.0	0.0	2.0	6,800	13.6	2.0		0			0.0	0.0	13.6	
CARBON FEED SCREW CONVEYOR	EA	2.0	0.0	0.0	2.0	25,000	50.0	2.0		0			0.0	0.0	50.0	
RICH BUTYL ACETATE FEED PUMP	EA	1.0	0.0	0.0	1.0	15,000	15.0	1.0		0			0.0	0.0	15.0	
FILTERED BROTH DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
BUTYL ACETATE & BUFFER CONTACT R	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
SEPARATOR VESSEL	EA	1.0	0.0	0.0	1.0	20,000	20.0	1.0		0			0.0	0.0	20.0	
pH METER SURGE VESSEL	EA	1.0	0.0	0.0	1.0	2,000	2.0	1.0		0			0.0	0.0	2.0	
RICH PENICILLIN FEED PUMP 4M3/HR	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
RICH PENICILLIN FEED PUMP 8M3/HR	EA	1.0	0.0	0.0	1.0	12,000	12.0	1.0		0			0.0	0.0	12.0	
BUTANOL FILTER	EA	1.0	0.0	0.0	1.0	5,000	5.0	1.0		0			0.0	0.0	5.0	
PENICILLIN SOLUTION FILTER	EA	1.0	0.0	0.0	1.0	5,000	5.0	1.0		0			0.0	0.0	5.0	
VACUUM SYSTEM	EA	2.0	0.0	0.0	2.0	170,000	340.0	2.0		0			0.0	0.0	340.0	
BUTANOL VESSEL	EA	1.0	0.0	0.0	1.0	10,000	10.0	1.0		0			0.0	0.0	10.0	
SOLVENT CONDENSER	EA	1.0	0.0	0.0	1.0	15,000	15.0	1.0		0			0.0	0.0	15.0	
SPENT SOLUTION CONDENSER	EA	1.0	0.0	0.0	1.0	15,000	15.0	1.0		0			0.0	0.0	15.0	
SPENT SOLUTION PRECONDENSER	EA	1.0	0.0	0.0	1.0	20,000	20.0	1.0		0			0.0	0.0	20.0	
OVERHEAD ACCUMULATOR	EA	1.0	0.0	0.0	1.0	15,000	15.0	1.0		0			0.0	0.0	15.0	
SPENT SOLVENT SURGE VESSEL	EA	1.0	0.0	0.0	1.0	15,000	15.0	1.0		0			0.0	0.0	15.0	
SPENT SOLVENT DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
DISTILLATE COOLER	EA	1.0	0.0	0.0	1.0	10,000	10.0	1.0		0			0.0	0.0	10.0	
DISTILLATE FEED PUMP	EA	1.0	0.0	0.0	1.0	7,000	7.0	1.0		0			0.0	0.0	7.0	
WEIGHER	EA	1.0	0.0	0.0	1.0	1,500	1.5	1.0		0			0.0	0.0	1.5	
SUB TOTAL PENICILLIN PURIFICATION							1,352.8			0			0.0	0.0	1,352.8	

[illegible] LIMITED for

MANDERSTAM CONSULTING SERVICES

OPTION 1 FULL PROCESS

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILLIN G UNIDO PHILIPPINES

DATE Jan 92
SHEET 4 of 6
BASE CASE i.e. WEST EUROPE BUILD

DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALLCE %	CUT & WASTE ALLCE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB-CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
EQUIPMENT PROCUREMENT contd																
6 APA PLANT																
APA1 PENICILLIN MAKE UP TANK	EA	1.0	0.0	0.0	1.0	25,000	25.0	1.0		0			0.0	0.0	25.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	12,500	12.5	1.0		0			0.0	0.0	12.5	
APA2 SCREW FEEDER	EA	1.0	0.0	0.0	1.0	8,000	8.0	1.0		0			0.0	0.0	8.0	
APA3 PENICILLIN DISCHARGE PUMP	EA	1.0	0.0	0.0	1.0	68,000	68.0	1.0		0			0.0	0.0	68.0	
APA4 ENZYME REACTOR	EA	1.0	0.0	0.0	1.0	40,000	40.0	1.0		0			0.0	0.0	40.0	
AGITATOR FOR ABOVE	EA	1.0	0.0	0.0	1.0	20,000	20.0	1.0		0			0.0	0.0	20.0	
APA5 ENZYME RECOVERY FILTER	EA	1.0	0.0	0.0	1.0	25,000	25.0	1.0		0			0.0	0.0	25.0	
APA6 ENZYME RECOVERY FEED PUMP	EA	1.0	0.0	0.0	1.0	20,500	20.5	1.0		0			0.0	0.0	20.5	
APA7 EVAPORATOR FEED TANK	EA	1.0	0.0	0.0	1.0	15,300	15.3	1.0		0			0.0	0.0	15.3	
APA8 CRYSTALISER FEED PUMP (GEAR)	EA	1.0	0.0	0.0	1.0	5,000	5.0	1.0		0			0.0	0.0	5.0	
APA9 CRYSTALISER	EA	2.0	0.0	0.0	2.0	15,000	30.0	2.0		0			0.0	0.0	30.0	
AGITATOR FOR ABOVE	EA	2.0	0.0	0.0	2.0	7,500	15.0	2.0		0			0.0	0.0	15.0	
APA10 BELT FILTER/WASHER	EA	1.0	0.0	0.0	1.0	10,200	10.2	1.0		0			0.0	0.0	10.2	
APA11 FLUID BED DRYER	EA	1.0	0.0	0.0	1.0	80,000	80.0	1.0		0			0.0	0.0	80.0	
APA12 EVAPORATOR	EA	1.0	0.0	0.0	1.0	35,000	35.0	1.0		0			0.0	0.0	35.0	
APA13 EVAPORATOR FEED PUMP	EA	1.0	0.0	0.0	1.0	10,000	10.0	1.0		0			0.0	0.0	10.0	
SUB TOTAL 6 APA PLANT							427.5			0			0.0	0.0	427.5	
EQUIPMENT PROCUREMENT SUMMARY																
SUB TOTAL - MEDIA PREPARATION							1,072.8			0			0.0	0.0	1,072.8	FROM SHEET 1
SUB TOTAL ADDITIVE PREPARATION							404.8			0			0.0	0.0	404.8	FROM SHEET 1
SUB TOTAL PENICILLIN FERMENTATION							2,708.8			0			0.0	0.0	2,708.8	FROM SHEET 1
SUB TOTAL DOWNSTREAM RECOVERY							843.4			0			0.0	0.0	843.4	FROM SHEET 2
SUB TOTAL PENICILLIN PURIFICATION							1,352.6			0			0.0	0.0	1,352.6	FROM SHEET 3
SUB TOTAL 6 APA PLANT							427.5			0			0.0	0.0	427.5	FROM SHEET 4 (THIS SHEET)
SUB TOTAL FLOWSHEET BASED							6,810.0			0			0.0	0.0	6,810.0	
ALLOW MISC MECHANICAL HANDLING	PS	1.0	0.0	0.0	1.0	100,000	100.0	1.0		0			0.0	0.0	100.0	MISC HOISTS/GANTRIES etc
UTILITIES	PS	1.0	0.0	0.0	1.0	5,918,900	5,918.9	1.0		0			0.0	0.0	5,918.9	SEE SEPARATE ESTIMATE
POWER GENERATION	PS	1.0	0.0	0.0	1.0	INC	0.0	1.0		0			0.0	0.0	0.0	INC IN UTILITIES
ALLOW DUST EXTRACTION	PS	1.0	0.0	0.0	1.0	INC	0.0	1.0		0			0.0	0.0	0.0	INC IN DOSAGE
ALLOW CONDITIONING SYSTEMS	PS	1.0	0.0	0.0	1.0	INC	0.0	1.0		0			0.0	0.0	0.0	INC IN DOSAGE
ALLOW BAGGING & PALLETISING	PS	1.0	0.0	0.0	1.0	INC	0.0	1.0		0			0.0	0.0	0.0	INC IN DOSAGE
DOSAGE SECTION	PS	1.0	0.0	0.0	1.0		601.0			0			0.0	0.0	601.0	SEE SEPARATE ESTIMATE
SEMI SYNTHETICS	PS	1.0	0.0	0.0	1.0		1,130.5			0			0.0	0.0	1,130.5	SEE SEPARATE ESTIMATE
SUB TOTAL IN ADDITION TO FLOWSHEETS							7,748.4			0			0.0	0.0	7,748.4	
ALLOW CIF/SHIPPING	10%						1,465.8			0			0.0	0.0	1,465.8	
TOTAL EQUIPMENT PROCUREMENT							16,124.2			0			0.0	0.0	16,124.2	

[illegible] LIMITED for
HANDERSTAM CONSULTING SERVICES

OPTION 1 FULL PROCESS

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILLIN G UNIDO PHILIPPINES

DATE Jan 92
SHEET 5 of 8
BASE CASE i.e. WEST EUROPE BUILD

DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB-CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB-CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
BULK MATERIAL PROCUREMENT																
PIPING	LOT	1.0	0.0	0.0	1.0		2,198.8	1.0		0			0.0	0.0	2,198.8	
ELECTRICAL	LOT	1.0	0.0	0.0	1.0		1,465.8	1.0		0			0.0	0.0	1,465.8	
INSTRUMENTATION	LOT	1.0	0.0	0.0	1.0		3,664.8	1.0		0			0.0	0.0	3,664.8	
COMMISSIONING SPARES	LOT	1.0	0.0	0.0	1.0		329.8	1.0		0			0.0	0.0	329.8	
SUB TOTAL BULK MATERIALS							7,659.0			0			0.0	0.0	7,659.0	
ALLOW. CIF/SHIPPING	5%						383.0			0			0.0	0.0	383.0	
TOTAL BULK MATERIAL PROCUREMENT							8,042.0			0			0.0	0.0	8,042.0	
CONSTRUCTION & SUB CONTRACTS																
MECHANICAL ERECTION	LOT	1.0	0.0	0.0	1.0		0.0	1.0		29,317	50.0		1,465.8	0.0	1,465.8	
PIPING FABRICATE/ERECTION	LOT	1.0	0.0	0.0	1.0		0.0	1.0		70,360	50.0		3,518.0	0.0	3,518.0	
STEEL SUPPLY/FABRICATE/ERECTION	LOT	1.0	0.0	0.0	1.0		703.6	1.0		21,108	50.0		1,055.4	0.0	1,759.0	
E & I INSTALLATION	LOT	1.0	0.0	0.0	1.0		0.0	1.0		71,826	50.0		3,591.3	0.0	3,591.3	
F & G SUPPLY/ERECTION	LOT	1.0	0.0	0.0	1.0		117.3	1.0		3,518	50.0		175.9	0.0	293.2	
INSULATION SUB CONTRACT	LOT	1.0	0.0	0.0	1.0		0.0	1.0		0		732,920	0.0	732.9	732.9	
PAINTING SUB CONTRACT	LOT	1.0	0.0	0.0	1.0		0.0	1.0		0		175,900	0.0	175.9	175.9	
CONTROL SYSTEM SUB CONTRACT	LOT	1.0	0.0	0.0	1.0		0.0	1.0		0		2,932,000	0.0	2,932.0	2,932.0	
SITE ESTABLISHMENT/ENABLING WORK	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		500,000	0.0	500.0	500.0	DEPENDANT ON SITE
CIVILS SUB CONTRACT	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		732,920	0.0	732.9	732.9	DEPENDANT ON SITE
PILING SUB CONTACT	EA	2,000.0	0.0	0.0	2,000.0		0.0	2,000.0		0		1,020	0.0	2,040.0	2,040.0	DEPENDANT ON SITE
BUILDINGS SUB CONTRACT	M2	3,375.0	0.0	0.0	3,375.0		0.0	3,375.0		0		2,174	0.0	7,337.5	7,337.5	SEE SEPARATE ESTIMATE
SCAFFOLDING SUB CONTRACT	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		490,000	0.0	490.0	490.0	
CRANE HIRE	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		250,000	0.0	250.0	250.0	
PRECOMMISSIONING	LOT	1.0	0.0	0.0	1.0		0.0	1.0		4,903	50.0		245.2	0.0	245.2	
TOTAL CONSTRUCTION & SUB-CONTRACTS							820.9			201,032			10,051.6	15,191.2	26,063.7	
MINOR SUPPORT CONTRACTS																
VENDOR REPRESENTATIVES	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		100,000	0.0	100.0	100.0	
PROCESS LICENSES	PS	1.0	0.0	0.0	1.0		0.0	1.0		0		691,000	0.0	691.0	691.0	10% x PROCESS EQUIPMENT
ENG SUPPORT DURING CONSTN	PS	1.0	0.0	0.0	1.0		0.0	1.0		6,000	75.0		450.0	0.0	450.0	
CONSULTANTS & STUDIES	PS	1.0	0.0	0.0	1.0		0.0	1.0		2,000	150.0		300.0	0.0	300.0	
TOTAL MINOR SUPPORT CONTRACTS							0.0			8,000			750.0	791.0	1,541.0	

[illegible] LIMITED for
MANDERSTAM CONSULTING SERVICES

OPTION 1 FULL PROCESS

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILLIN G - UNIDO - PHILIPPINES

DATE Ja[illegible]
SHEET [illegible]
BASE CASE 1 = WEST EUROPE BUILD

DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB-CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB-CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
MAJOR SUPPORT CONTRACTS																
CONCEPTUAL ENGINEERING	HRS	1.0	0.0	0.0	1.0		0.0	1.0		12,000	65.0		780.0	0.0	780.0	
DETAIL ENGINEERING NATIONALS	HRS	1.0	0.0	0.0	1.0		0.0	1.0		120,000	60.0		7,200.0	0.0	7,200.0	
DETAIL ENGINEERING EXPATS	HRS	0.0	0.0	0.0	0.0		0.0	0.0		0			0.0	0.0	0.0	NOT APPLICABLE TO BASE CASE
CONSTRUCTION SUPVN NATIONALS	HRS	1.0	0.0	0.0	1.0		0.0	1.0		32,000	60.0		1,920.0	0.0	1,920.0	
CONSTRUCTION SUPVN EXPATS	HRS	0.0	0.0	0.0	0.0		0.0	0.0		0			0.0	0.0	0.0	NOT APPLICABLE TO BASE CASE
COMMISSIONING NATIONALS	HRS	1.0	0.0	0.0	1.0		0.0	1.0		3,300	60.0		198.0	0.0	198.0	5 MEN x 3MTHS @ 220HRS/MTH
COMMISSIONING EXPATS	HRS	0.0	0.0	0.0	0.0		0.0	0.0		0			0.0	0.0	0.0	NOT APPLICABLE TO BASE CASE
COMMISSIONING TRADES	HRS	1.0	0.0	0.0	1.0		0.0	1.0		6,600	42.5		280.5	0.0	280.5	10 MEN x 3MTHS @ 220HRS/MTH
TOTAL MAJOR SUPPORT CONTRACTS							0.0			173,900			10,378.5	0.0	10,378.5	
TOTAL EQUIPMENT PROCUREMENT							16,124.2			0			0.0	0.0	16,124.2	
TOTAL BULK MATERIAL PROCUREMENT							8,042.0			0			0.0	0.0	8,042.0	
TOTAL CONSTRUCTION & SUB CONTRACTS							820.9			201,032			10,051.6	15,191.2	26,063.7	
TOTAL MINOR SUPPORT CONTRACTS							0.0			8,000			750.0	791.0	1,541.0	
TOTAL MAJOR SUPPORT CONTRACTS							0.0			173,900			10,378.5	0.0	10,378.5	
TOTAL COST ESTIMATE - EXCL CONTINGENCIES & ESCALATION							24,987.1			382,932			21,180.1	15,982.2	62,149.4	

COALBREEZE LIMITED for

HANDERSTAM CONSULTING SERVICES

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILLIN G - UNIDO - PHILIPPINES

DATE Jan 02
SHEET 1 of 1

DOSAGE SECTION

	DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB-CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB-CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
	EQUIPMENT PROCUREMENT																
DOSAGE																	
D1	WEIGH SCALE	EA	1.0	0.0	0.0	1.0	1,500	1.5	1.0		0			0.0	0.0	1.5	
D2	CONTAINER	EA	2.0	0.0	0.0	2.0	1,400	2.8	2.0		0			0.0	0.0	2.8	
D3	CONTAINER	EA	2.0	0.0	0.0	2.0	200	0.4	2.0		0			0.0	0.0	0.4	
D4	SIFTING MACHINE	EA	1.0	0.0	0.0	1.0	6,000	6.0	1.0		0			0.0	0.0	6.0	
D5	POWDER BLENDER	EA	1.0	0.0	0.0	1.0	12,000	12.0	1.0		0			0.0	0.0	12.0	
D6	SCOOP	SET	2.0	0.0	0.0	2.0	100	0.2	2.0		0			0.0	0.0	0.2	
D7	WEIGH SCALE	EA	1.0	0.0	0.0	1.0	1,200	1.2	1.0		0			0.0	0.0	1.2	
D8	VAC[illegible]M CLEANER	EA	1.0	0.0	0.0	1.0	300	0.3	1.0		0			0.0	0.0	0.3	
D9	CAPS[illegible]LE FILLING MACHINE	EA	1.0	0.0	0.0	1.0	170,000	170.0	1.0		0			0.0	0.0	170.0	
D10	POWDER FILLING M/C & CONVEYORS	EA	1.0	0.0	0.0	1.0	32,400	32.4	1.0		0			0.0	0.0	32.4	
D11	CAPSULE FILLING M/C & CONVEYORS	EA	1.0	0.0	0.0	1.0	51,800	51.8	1.0		0			0.0	0.0	51.8	
D12	SELF ADHESIVE LABEL DISPENSERS	EA	1.0	0.0	0.0	1.0	3,000	3.0	1.0		0			0.0	0.0	3.0	
D13	CHECK WEIGHT BALANCE	EA	1.0	0.0	0.0	1.0	700	0.7	1.0		0			0.0	0.0	0.7	
D14	FOOT OPERATED LID CLOSER	EA	1.0	0.0	0.0	1.0	1,100	1.1	1.0		0			0.0	0.0	1.1	
D15	WRAPPER 'L' SEALER	EA	1.0	0.0	0.0	1.0	3,100	3.1	1.0		0			0.0	0.0	3.1	
D16	TUNNEL	EA	1.0	0.0	0.0	1.0	8,870	8.8	1.0		0			0.0	0.0	8.8	
D17	PALLET TRUCK	EA	1.0	0.0	0.0	1.0	500	0.5	1.0		0			0.0	0.0	0.5	
D18	BATCH No/DATA PRINTER	EA	1.0	0.0	0.0	1.0	15,120	15.1	1.0		0			0.0	0.0	15.1	
	DUST EXTRACTION	LOT	1.0	0.0	0.0	1.0	289,000	289.0	1.0		0			0.0	0.0	289.0	
	TOTAL DOSAGE SECTION - WEST EUROPE BUILD							601.0			0			0.0	0.0	601.0	
	TOTAL DOSAGE SECTION - FILIPINO BUILD							420.7			0			0.0	0.0	420.7	ASSUME 70% AVG ON EUROPE

GEAL BREEZE LIMITED for
HANDERSTAM CONSULTING SERVICES

SEMI SYNTHETICS

ORDER OF MAGNITUDE COST ESTIMATE for
PENICILLIN G - UNIDO - PHILIPPINES

DATE Jan 92
SHEET 1 of 1

DESCRIPTION	UNIT	BASE QTY	DESIGN GROWTH ALL'CE %	CUT & WASTE ALL'CE %	PURCH QTY	PURCH US$ UNIT RATE	PURCH COST US$ x 1000	INST'D QTY	INST'N MHR UNIT RATE	MHRS	LAB RATE US$ PER MHR	SUB-CONTRACT US$ UNIT RATE	LAB COST US$ x 1000	SUB-CONTRACT US$ x 1000	TOTAL COSTS US$ x 1000	REMARKS
EQUIPMENT PROCUREMENT																
SEMI SYNTHETICS																
SS1 REACTOR	EA	3 0	0 0	0 0	3 0	20,000	60 0	3 0		0			0 0	0 0	60 0	
AGITATOR FOR ABOVE	EA	3 0	0 0	0 0	3 0	10,000	30 0	3 0		0			0 0	0 0	30 0	
SS2 FEED TANK	EA	3 0	0 0	0 0	3 0	12,500	37 5	3 0		0			0 0	0 0	37 5	
SS3 FEED TANK	EA	2 0	0 0	0 0	2 0	37,500	75 0	2 0		0			0 0	0 0	75 0	
SS4 METERING SCREW FEEDER	EA	3 0	0 0	0 0	3 0	30,000	90 0	3 0		0			0 0	0 0	90 0	
SS5 REACTOR	EA	2 0	0 0	0 0	2 0	40,000	80 0	2 0		0			[illegible]	0 0	80 0	
AGITATOR FOR ABOVE	EA	1 0	0 0	0 0	1 0	20,000	20 0	1 0		0			0 0	0 0	20 0	
SS6 IN LINE FILTER	EA	1 0	0 0	0 0	1 0	5,000	5 0	1 0		0			0 0	0 0	5 0	
SS7 CENTIFUGE	EA	2 0	0 0	0 0	2 0	25,000	50 0	2 0		0			0 0	0 0	50 0	
SS8 FLUID BED DRYER	EA	2 0	0 0	0 0	2 0	90,000	180 0	2 0		0			0 0	0 0	180 0	
SS9 ROTARY VACUUM FILTER	EA	1 0	0 0	0 0	1 0	130,000	130 0	1 0		0			0 0	0 0	130 0	
SS10 RECEIVER TANK	EA	4 0	0 0	0 0	4 0	56,250	225 0	4 0		0			0 0	0 0	225 0	
SS11 SOLVENT RECOVERY UNIT	EA	1 0	0 0	0 0	1 0	100,000	100 0	1 0		0			0 0	0 0	100 0	
SS12 TRANSFER PUMP - CENTRIFUGAL	EA	4 0	0 0	0 0	4 0	7,000	28 0	4 0		0			0 0	0 0	28 0	
SS13 TRANSFER PUMP - GEAR	EA	4 0	0 0	0 0	4 0	5,000	20 0	4 0		0			0 0	0 0	20 0	
TOTAL DOSAGE SECTION - WEST EUROPE BUILD							1,130 5			0			0 0	0 0	1,130 5	
TOTAL DOSAGE SECTION - FILIPINO BUILD							791 3			0			0 0	0 0	791 3	ASSUME 70% AVG ON EUROPE

COALBREEZE LIMITED for

MANDERSTAM CONSULTING SERVICES

DATE Feb-92

SHEET 1 OF 1

BUILDINGS – PENICILIN G – UNIDO – PHILLIPINES

BUILD TYPE	ITEM DESCRIPTION	OPTION 1			OPTION 2			OPTION 3		
		M2	$ RATE	$ x 1000	M2	$ RATE	$ x 1000	M2	$ RATE	$ x 1000
2	TRANSFORMER SUB-STN	25	2,500	62.5	20	2,500	25.0	400	2,500	1,000.0
1	FERMENTATION	1,000	2,000	2,000.0	0	2,000	0.0	1,000	2,000	2,000.0
2	EXTRACTION	400	2,500	1,000.0	0	2,500	0.0	400	2,500	1,000.0
2	6-APA	400	2,500	1,000.0	400	2,500	1,000.0	400	2,500	1,000.0
3	PILOT PLANT	100	1,500	150.0	0	1,500	0.0	100	1,500	150.0
3	LABORATORY	150	1,500	225.0	50	1,500	75.0	150	1,500	225.0
3	OFFICES	150	1,500	225.0	50	1,500	75.0	150	1,500	225.0
2	COMPRESSOR HOUSE	100	2,500	250.0	100	2,500	250.0	100	2,500	250.0
2	SOLVENT RECOVERY	50	2,500	125.0	0	2,500	0.0	50	2,500	125.0
1	WAREHOUSE	400	2,000	800.0	200	2,000	400.0	400	2,000	800.0
2	DOSAGE	300	2,500	750.0	300	2,500	750.0	0	2,500	0.0
2	SEMI- SYNTHETICS	300	2,500	750.0	300	2,500	750.0	0	2,500	0.0
	TOTALS – W.EUROPE BUILD	3,375	2,174	7,337.5	1,420	2,342	3,325.0	3,150	2,151	6,775.0

	OPTION 1	OPTION 2	OPTION 3
LAND REQUIREMENTS M2	10,000	4,970	10,000
No. OFF PILES @ 1/5M2	2,000	995	2,000

BUILD TYPE	ITEM DESCRIPTION	OPTION 1			OPTION 2			OPTION 3		
		M2	No. OFF	$ x 1000	M2	No. OFF	$ x 1000	M2	No. OFF	$ x 1000
2	TRANSFORMER SUB-STN	25	1,250	31.3	20	1,250	25.0	400	1,250	500.0
1	FERMENTATION	1,000	1,000	1,000.0	0	1,000	0.0	1,000	1,000	1,000.0
2	EXTRACTION	400	1,250	500.0	0	1,250	0.0	400	1,250	500.0
2	6-APA	400	1,250	500.0	400	1,250	500.0	400	1,250	500.0
3	PILOT PLANT	100	750	75.0	0	750	0.0	100	750	75.0
3	LABORATORY	150	750	112.5	50	750	37.5	150	750	112.5
3	OFFICES	150	750	112.5	50	750	37.5	150	750	112.5
2	COMPRESSOR HOUSE	100	1,250	125.0	100	1,250	125.0	100	1,250	125.0
2	SOLVENT RECOVERY	50	1,250	62.5	0	1,250	0.0	50	1,250	62.5
1	WAREHOUSE	400	1,000	400.0	200	1,000	200.0	400	1,000	400.0
2	DOSAGE	300	1,250	375.0	300	1,250	375.0	0	1,250	0.0
2	SEMI- SYNTHETICS	300	1,250	375.0	300	1,250	375.0	0	1,250	0.0
	TOTALS – FILIPINO BUILD	3,375	1,087	3,668.8	1,420	1,180	1,675.0	3,150	1,075	3,387.5

BUILDING TYPE 1 = STEEL FRAMED, CLAD WALLS & ROOF, UNINSULATED, CONCRETE FLOOR, ACCESS DOORS FOR EQUIPMENT, STEEL FRAMED SUPPORTS FOR PROCESS VESSELS, STD ELECTRICAL EQUIPMENT.

BUILDING TYPE 2 = AS 1 ABOVE BUT EXPLOSION PROOF ELECTRICAL EQUIPMENT.

BUILDING TYPE 3 = STEEL FRAMED, BRICK WALLS, CLAD ROOF, INSULATED, AIR CONDITIONED.

COALBREEZE LIMITED for

MANDERSTAM CONSULTING SERVICES

DATE Jan 92

SHEET 1 OF 1

UTILITY EQUIPMENT - PENICILIN G - UNIDO - PHILLIPINES

ITEM No.	ITEM DESCRIPTION	OPTION 1			OPTION 2			OPTION 3		
		CAP	No. OFF	$ x 1000	CAP	No. OFF	$ x 1000	CAP	No. OFF	$ x 1000
U1	STEAM BOILER	10T/HR	2	680.0	2T/HR	2	226.7	10T/HR	2	680.0
U2	TRANSFORMER SUB STN	8MW	1	166.6	1.5MW	1	31.2	8MW	1	166.6
U3	SOLVENT DISTILLATION UNIT	1T/HR	1	170.0	N/R	0	0.0	1T/HR	1	170.0
U4	CHILLED H2O REFRIGERATOR	3MW	1	850.0	200KW	1	170.0	3MW	1	850.0
U5	BRINE REFRIGERATOR	2MW	1	425.0	2MW	1	425.0	2MW	1	425.0
U6	COOLING TOWER	1700M3/H	1	850.0	500M3/H**	1	283.3	1700M3/H	1	850.0
U7	LIQUID NITROGEN COOLER	150KW	1	255.0	150KW	1	255.0	150KW	1	255.0
U8	COMPRESSOR	660NM3/D	1	1,188.6	N/R	0	0.0	660NM3/D	1	1,188.6
U9	H2O TREATMENT PLANT	60M3/HR	1	425.0	N/R	0	0.0	60M3/HR	1	425.0
U10	STANDBY DIESEL GENERATOR	500KW	3	906.7	N/R	0	0.0	500KW	3	906.7
	TOTALS W EUROPE BUILD			5,916.9			1,391.2			5,916.9

** – EST

ITEM No.	ITEM DESCRIPTION	OPTION 1			OPTION 2			OPTION 3		
		CAP	No. OFF	$ x 1000	CAP	No. OFF	$ x 1000	CAP	No. OFF	$ x 1000
U1	STEAM BOILER	10T/HR	2	476.0	2T/HR	2	158.7	10T/HR	2	476.0
U2	TRANSFORMER SUB STN	8MW	1	116.6	1.5MW	1	21.9	8MW	1	116.6
U3	SOLVENT DISTILLATION UNIT	1T/HR	1	119.0	N/R	0	0.0	1T/HR	1	119.0
U4	CHILLED H2O REFRIGERATOR	3MW	1	595.0	200KW	1	119.0	3MW	1	595.0
U5	BRINE REFRIGERATOR	2MW	1	297.5	2MW	1	297.5	2MW	1	297.5
U6	COOLING TOWER	1700M3/H	1	595.0	500M3/H**	1	198.3	1700M3/H	1	595.0
U7	LIQUID NITROGEN COOLER	150KW	1	178.5	150KW	1	178.5	150KW	1	178.5
U8	COMPRESSOR	660NM3/D	1	832.0	N/R	0	0.0	660NM3/D	1	832.0
U9	H2O TREATMENT PLANT	60M3/HR	1	297.5	N/R	0	0.0	60M3/HR	1	297.5
U10	STANDBY DIESEL GENERATOR	500KW	3	634.7	N/R	0	0.0	500KW	3	634.7
	TOTALS FILIPINO BUILD			4,141.8			973.9			4,141.8

UNIDO PENICILLIN PROJECT : OPTION A

Appendix 10-11

PROJECTED BALANCE SHEET

in Pesos '000

Year	1993	1994	1995	1996	1997	1998	1999
ASSETS	706,540	1,506,540	1,471,810	1,361,891	1,240,035	1,096,702	951,909
1. Fixed Assets							
- Land	20,350	20,350	20,350	20,350	20,350	20,350	20,350
- Buildings	90,983	454,914	432,169	409,424	386,679	363,934	341,189
- Plant & Machinery	63,315	531,255	542,836	514,266	485,696	457,126	428,556
- Vehicles	0	6,930	5,544	4,158	2,772	1,386	0
- Service Equipment	0	12,870	11,583	10,296	9,009	7,722	6,435
- Intangibles	208,758	439,121	373,647	280,235	186,823	93,411	0
	383,406	1,465,440	1,386,129	1,238,729	1,091,329	943,929	796,530
2. Current Assets							
- Accounts Receivable	0	0	17,837	25,493	30,811	31,614	32,192
- Inventory	0	0	61,997	91,476	112,266	116,228	118,956
- Cash in Hand	0	0	5,847	6,193	5,629	4,931	4,231
- Cash Balance	323,134	41,100	0	0	0	0	0
	323,134	41,100	85,681	123,162	148,706	152,773	155,379
LIABILITIES	706,540	1,506,540	1,471,810	1,361,891	1,240,035	1,096,702	951,909
1. Equity Capital	672,894	672,894	672,894	672,894	672,894	672,894	672,894
2. Revenue Reserves	0	0	(280,578)	(558,326)	(812,105)	(1,034,335)	(1,224,849)
3. Term Borrowings							
- Foreign Currency Loan	33,646	833,646	938,786	751,029	563,272	375,515	187,758
- Local Currency Loan	0	0	0	45,824	30,549	15,274	0
	33,646	833,646	938,786	796,853	593,821	390,789	187,758
4. Current Liabilities							
- Accounts Payable	0	0	12,402	19,694	24,730	25,359	25,766
- Cash Shortfall	0	0	128,306	430,776	760,695	1,041,995	1,290,340
	0	0	140,708	450,470	785,425	1,067,354	1,316,106

APPENDIX 10-11

PROJECTED BALANCE SHEET : OPTION A

1. **Assets**

1.1 The figures quoted in respect of fixed assets reflect the value of the project investment by individual category, net of depreciation calculated at the rates specified in section 7.1 of Appendix 10-9.

1.2 The figures quoted in respect of accounts receivable, total inventory and cash in hand have been taken directly from the schedule detailing the working capital requirement in each year presented at Appendix 10-4.

1.3 For the purpose of the financial projections, it has been assumed that all cash surpluses reflected in the cash flow table at Appendix 10-10 would be retained as cash balances.

2. **Liabilities**

2.1 It has been assumed that there would be no change in the shareholding structure and, more specifically, no further increase in the issued and paid-up share capital to that detailed in the initial financing plan.

2.2 The figures quoted in respect of revenue reserves have been taken directly from the net income statement presented at Appendix 10-9, and reflect the accumulated loss position of the project.

2.3 Provision has been made for the foreign and local currency loans to be drawndown as per the initial financing plan detailed in Appendix 10-7, and to be repaid as specified in the cash flow table at Appendix 10-10.

2.4 The figures quoted in respect of accounts payable have been taken directly from the schedule detailing the working capital requirement in each year set out in Appendix 10-4.

2.5 The figures quoted in respect of the cash shortfall have been taken directly from the cash flow table presented at Appendix 10-10, and reflect the accumulated cash deficits of the project.

UNIDO PENICILLIN PROJECT : OPTION A

Appendix 10-12

CASH FLOW TABLE : TOTAL INVESTMENT

in Pesos '000

Year	0	1	2	3	4	5
CASH INFLOWS						
1. Sales Revenues	0	155,965	254,620	325,475	347,818	367,628
CASH OUTFLOWS	(1,465,440)	(355,408)	(336,109)	(390,243)	(382,806)	408,028
1. Total Investment Outlay	(1,465,440)	(141,368)	(30,189)	(20,508)	(3,438)	(2,199)
2. Residual Value of Assets	0	0	0	0	0	796,530
3. Operating Costs	0	(214,040)	(305,920)	(369,735)	(379,368)	(386,303)
4. Corporate Tax	0	0	0	0	0	0
NET CASH FLOW	(1,465,440)	(199,443)	(81,489)	(64,768)	(34,988)	775,656
Internal Rate of Return	-17.4%					
Net Present Value @ 19%	(1,194,477)					
Cumulative Net Cash Flow	(1,465,440)	(1,664,883)	(1,746,372)	(1,811,140)	(1,846,128)	(1,070,472)

UNIDO PENICILLIN PROJECT : OPTION A

CASH FLOW TABLE : EQUITY CAPITAL

Appendix 10-12

in Pesos '000

Year	0	1	2	3	4	5
CASH INFLOWS						
1. Sales Revenues	0	155,965	254,620	325,475	347,818	367,628
CASH OUTFLOWS	(672,894)	(289,143)	(572,725)	(634,886)	(625,680)	182,756
1. Equity Subscription	(672,894)	0	0	0	0	0
2. Replacement Investment	0	0	0	0	0	0
3. Residual Value of Assets	0	0	0	0	0	796,530
4. Debt Service :Repayments						
- Forex Loan	0	0	(187,757)	(187,757)	(187,757)	(187,757)
- Local Loan	0	0	0	(15,275)	(15,275)	(15,274)
5. Debt Service : Interest						
- Forex Loan	0	(75,103)	(67,592)	(52,572)	(37,552)	(22,531)
- Local Loan	0	0	(11,456)	(9,547)	(5,728)	(1,909)
6. Operating Costs	0	(214,040)	(305,920)	(369,735)	(379,368)	(386,303)
7. Corporate Tax	0	0	0	0	0	0
NET CASH FLOW	(672,894)	(133,178)	(318,105)	(309,411)	(277,862)	550,384

Internal Rate of Return -32.4%

Net Present Va ue @ 19% (925,189)

APPENDIX 10-12

CASH FLOW TABLES : OPTION A

1. Total Investment

1.1 The figures quoted in respect of sales revenues, operating costs and corporate taxation have been taken directly from the net income statement presented at Appendix 10-9.

1.2 The figures quoted in respect of the total investment outlay have been taken directly from the schedule presented at Appendix 10-5, and reflect the sum of the initial investment costs, pre-production capital expenditures and the increase in working capital requirements in each year. For the purpose of these calculations, the investment outlay in the project implementation phase has been combined as one total.

1.3 The residual value of the assets reflects the total book value of the fixed assets of the project in 1999, as per the projected balance sheet presented at Appendix 10-11.

2. Equity Capital

2.1 The figures quoted in respect of sales revenues, operating costs and corporate taxation have been taken directly from the net income statement presented at Appendix 10-9.

2.2 The figures quoted in respect of equity subscription have been taken directly from the initial financing plan set out in Appendix 10-7.

2.3 It has been assumed that there would be no replacement investment during the period under review.

2.4 The residual value of the assets reflects the total book value of the fixed assets of the project in 1999, as per the projected balance sheet presented at Appendix 10-11.

2.5 The figures quoted in respect of debt service (repayments and interest) have all been taken directly from the cash flow table for financial planning which is presented at Appendix 10-10.

UNIDO PENICILLIN PROJECT : OPTION B

Appendix 11-1

INITIAL FIXED INVESTMENT COSTS

in Pesos 000

	Foreign Currency	Local Currency	Total Cost
1. Land			
Land Purchase	0	6,000	6,000
10% Contingency Allowance	0	600	600
	0	6,600	6,600
2. Site Preparation/Development			
Site Establishment & Development	0	1,950	1,950
10% Contingency Allowance	0	195	195
	0	2,145	2,145
3.1 Buildings & Civil Works			
Civils, Piling, Scaffolding, etc	0	16,890	16,890
Buildings - Fermentation etc	0	0	0
Buildings - 6-APA	0	13,000	13,000
Buildings - Semi-Synthetics	0	19,500	19,500
Mechanical, Piping, Steel Suppl	17,631	1,763	19,394
E&I Installation	9,152	915	10,067
Insulation, Painting	0	1,784	1,784
Control System	0	8,0[illegible]	8,0[illegible]
Pre-Commissioning	624	0	624
10% Contingency Allowance	2,741	6,191	8,932
	30,148	68,103	98,251
3.2 Auxiliary & Service Facilities			
Transformer Sub-Station	0	650	650
Compressor House	0	3,250	3,250
Laboratory, Offices, Warehouse	0	7,150	7,150
Administration Block	0	5,850	5,850
10% Contingency Allowance	0	1,690	1,690
	0	18,590	18,590
4. Incorporated Fixed Assets			
Process Licences	778		778
Technology Transfer	0		
10% Contingency Allowance	78	0	78
	856	0	856

	Foreign Currency	Local Currency	Total Cost
5.1 Production Machinery & Equipment			
Media Preparation	0	0	0
Additive Preparation	0	0	0
Penicillin Fermentation	0	0	0
Downstream Recovery	0	0	0
Penicillin Purification	0	0	0
6-APA Plant	7,781	776	8,557
Semi-Synthetics Production	20,575	2,058	22,633
Dosage Section	10,938	1,094	12,032
Packing, Insurance & Shipping	3,929	0	3,929
10% Contingency Allowance	4,322	393	4,715
	47,545	4,323	51,868
5.2 Ancillary Production Equipment			
Piping	9,828	983	10,811
Electrical	6,552	655	7,207
Instrumentation	16,360	1,658	18,018
Commissioning Spares	1,474	147	1,621
Packing, Insurance & Shipping	1,712	0	1,712
10% Contingency Allowance	3,595	342	3,937
	39,541	3,765	43,306
5.3 Auxiliary Equipment			
Utilities	25,321	2,532	27,853
Mechanical Handling	910	91	1,001
Workshop Equipment	2,600	260	2,860
Laboratory Equipment	1,300	130	1,430
Packing, Insurance & Shipping	3,013	0	3,013
10% Contingency Allowance	3,314	301	3,615
	36,458	3,314	39,772
5.4 Vehicles			
Company Cars - Senior Management	0	1,600	1,600
Company Cars - Sales & Distribution	0	2,800	2,800
Lorry, Pick-up Truck, Fork-Lift	0	1,900	1,900
10% Contingency Allowance	0	630	630
	0	6,930	6,930
5.5 Service Equipment			
Office Equipment & Furniture	0	6,500	6,500
Canteen & Medical Facilities	0	2,600	2,600
10% Contingency Allowance	0	910	910
	0	10,010	10,010
Total	154,548	123,780	278,328

APPENDIX 11-1

INITIAL FIXED INVESTMENT COSTS : OPTION B

1. Land

1.1 It has been assumed that the project would be located in the Light Industry and Science Park in the Calabar region. The cost of a suitable site measuring 5,000 sq.m. in total has been based on an average price of P 1,200 per sq.m., as per information obtained in the Philippines.

1.2 Provision has been made for a contingency allowance of 10%, calculated by reference to the purchase price of the land.

2. Site Preparation and Development

2.1 The price quoted of P 1.95 million should cover all initial site preparation and subsequent development work, including landscaping, internal roadways and parking areas, security fencing and gatehouse, connections to mains electricity and water, etc.

2.2 Provision has been made for a contingency allowance of 10%, calculated by reference to the total cost estimate.

3. Buildings and Civil Works

3.1 The prices quoted are in accordance with the detailed cost estimates presented at Appendix 9-2, converted into Pesos.

3.2 Further provision has been made for payment of 10% customs duties on all imported items (mechanical erection, piping, steel supply, fire/gas supply, electrics and instrumentation installation), and for an overall 10% contingency allowance.

4. Incorporated Fixed Assets

4.1 The cost of process licensing has been estimated at 10% of the process equipment, as per the detailed cost estimates presented at Appendix 9-2. No provision has been made in respect of technology transfer, given that the project would not be undertaking the in-house production of penicillin.

4.2 Provision has been made for a contingency allowance of 10%, calculated by reference to the total cost estimate.

5. <u>Production/Auxiliary Machinery and Equipment</u>

5.1 The prices quoted are in accordance with the detailed cost estimates presented at Appendix 9-2, converted into Pesos.

5.2 Further provision has been made for payment of 10% customs duties on all imported items, and for an overall contingency allowance of 10%.

6. <u>Vehicles</u>

6.1 It has been assumed that the project would require the following vehicles, all of which could be purchased from local suppliers :

4 x Company Cars - Senior Management
7 x Company Cars - Sales and Distribution Staff
1 x 3-tonne Lorry
1 x Pick-up Truck or Van
1 x Fork-lift Truck

6.2 The prices quoted have been based on information obtained in the Philippines. Separate provision has been made for a contingency allowance of 10%, calculated by reference to the total cost estimate.

7. <u>Service Equipment</u>

7.1 It has been assumed that all office equipment and furniture would be purchased from local suppliers, as would canteen and medical facilities for the project staff. The cost of these items has been estimated by reference to the nature of the project and the number of employees.

7.2 Separate provision has been made for a contingency allowance of 10%, calculated by reference to the total cost estimate.

UNIDO PENICILLIN PROJECT : OPTION B　　　　　Appendix II-2

INITIAL FIXED INVESTMENT COST SCHEDULE

in Pesos '000

Year	[illegible]	1994	1995
1. Land			
- Foreign Currency	0	[illegible]	0
- Local Currency	[illegible]	0	0
- Total	[illegible]	0	0
2. Site Preparation/Development			
- Foreign Currency	[illegible]	0	[illegible]
- Local Currency	2,145	[illegible]	0
- Total	2,145	0	0
3. Structures & Civil Works			
- Foreign Currency	[illegible]	24,118	[illegible]
- Local Currency	[illegible]	[illegible]	0
- Total	[illegible]	[illegible]	[illegible]
4. Incorporated Fixed Assets			
- Foreign Currency		428	428
- Local Currency		0	0
- Total		428	428
5. Plant, Machinery & Equipment			
- Foreign Currency	[illegible]	[illegible]	8,554
- Local Currency	[illegible]	[illegible]	765
- Total	[illegible]	128,[illegible]19	9,3[illegible]
6. Total Initial Investment Costs			
- Foreign Currency	[illegible]	[illegible]	6,982
- Local Currency	[illegible]	[illegible]	795
Total	[illegible]	221,919	[illegible],767

APPENDIX 11-2

INITIAL FIXED INVESTMENT COST SCHEDULE : OPTION B

1. Land and Site Development

1.1 It has been assumed that the entire cost of purchasing and developing the project site would be incurred in 1993, this being the first year of project implementation.

2. Structures and Civil Works

2.1 It has been assumed that 20% of the cost of the structures and civil works would be incurred in 1993, and the balance of 80% upon completion of this work in 1994.

3. Incorporated Fixed Assets

3.1 It has been assumed that 50% of the cost of the process licences would be incurred in 1994, and the balance of 50% upon the commencement of operations in 1995.

4. Production Machinery and Equipment

4.1 It has been assumed that the suppliers of the production machinery and equipment would require a 20% downpayment in 1993, and that a further 70% of the total purchase price would be payable in 1994. Provision has therefore been made for retention of the balance of 10% until the commencement of operations in 1995, by way of performance guarantee.

5. Ancillary and Auxiliary Equipment

5.1 It has been assumed that the suppliers of the ancillary production equipment and of the auxiliary equipment would also require a 5% downpayment in 1993, and that a further 90% of the total purchase price would be payable in 1994. Provision has again been made for retention of the balance of 5% until 1995, by way of performance guarantee.

6. Vehicles and Service Equipment

6.1 It has been assumed that the entire cost of purchasing the vehicles, office equipment/furniture and canteen/medical facilities required would be incurred in the final phase of project implementation in 1994, immediately prior to the start-up of operations.

UNIDO PENICILLIN PROJECT : OPTION B

Appendix 11-3

PRE-PRODUCTION EXPENDITURE SCHEDULE

in Pesos '000

Year	1993	1994	1995
1. Pre-Investment Studies			
- Foreign Currency	4,290	0	0
2. Preparatory Engineering Studies			
- Foreign Currency	12,26[illegible]	0	0
3. Management of Project Implementation			
- Foreign Currency	1,464	5,516	0
4. Detailed Engineering-Tendering			
- Foreign Currency	67,954	45,302	0
5. Supervision, Testing and Commissioning			
- Foreign Currency	5,545	34,178	0
- Local Currency	1,112	4,464	0
- Total	[illegible]	38,642	0
6. Recruitment and Staff Training			
- Foreign Currency	0	7,800	0
- Local Currency	0	1,300	0
- Total	0	9,100	0
7. Arrangements for Supplies			
- Local Currency		51[illegible]	[illegible]
8. Arrangements for Marketing			
- Local Currency		2,060	[illegible]
9. Build-up of Connections			
- Local Currency	51	78[illegible]	[illegible]
10. Capital Issue Expenditure			
- Local Currency	[illegible]	5,2[illegible]	0
11. 10% Contingency Allowance			
- Foreign Currency	9,44[illegible]	7,29[illegible]	0
- Local Currency	2[illegible]	1,434	[illegible]
- Total	[illegible]	10,724	0
12. Total Pre-Production Expenditure			
- Foreign Currency	103,998	102,186	0
- Local Currency	3,22[illegible]	15,776	0
Total	107,[illegible]	117,964	0

APPENDIX 11-3

PRE-PRODUCTION EXPENDITURE SCHEDULE : OPTION B

1. Pre-Investment and Preparatory Engineering Studies

1.1 It has been assumed that the entire cost of pre-investment and preliminary engineering studies would be incurred in the earliest phase of project implementation in 1993.

2. Management of Project Implementation

2.1 It has been assumed that 20% of the cost of the management team in charge of project implementation would be incurred during 1993, and the balance of 80% during 1994.

3. Detailed Engineering and Tendering

3.1 It has been assumed that 60% of the cost of the detailed engineering work to be undertaken would be incurred during 1993, and the balance of 40% during 1984.

4. Supervision, Testing and Commissioning

4.1 It has been assumed that 20% of the total combined cost of supervising the buildings and civil works, and testing and commissioning the plant and equipment, would be incurred during 1993, and the balance of 80% during 1994.

5. Recruitment and Staff Training

5.1 It has been assumed that the entire cost of recruiting staff and sending them for advance training overseas would be incurred in 1994, immediately prior to the commencement of operations.

6. Arrangements for Supplies and Marketing

6.1 It has been assumed that all preliminary expenditure in respect of arrangements for supplies and marketing would be incurred in 1994, prior to the start-up of operations.

7. Build-up of Connections and Capital Issue Expenditure

7.1 It has been assumed that 40% of the cost of project and other approvals and 20% of the cost of legal and other fees related to the registration and financing of the project would be incurred in 1993, with the respective balances of 60% and 80% falling due in 1994.

UNITO PENICILLIN PROJECT : OPTION [illegible]

Appendix II-4

WORKING CAPITAL REQUIREMENTS

in Pesos 000

	Minimum Coverage	Turnover Coefficient	1995	1996	1997	1998	1999	2000	2001	2002
1. Current Assets										
a. Accounts Receivable	[illegible]	12	[illegible]	[illegible]	[illegible]	[illegible]	24,656	[illegible]	[illegible]	[illegible]
b. Inventory:										
- Local Materials	1	36								
- Imported Materials	12	3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	94,167	[illegible]
- Spare Parts	180	[illegible]	1,350	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
- Work-in-Progress	[illegible]	12	11,295	[illegible]	[illegible]	22,407	[illegible]	[illegible]	[illegible]	[illegible]
Finished Products	[illegible]	12	12,130	16,174	[illegible]	[illegible]	[illegible]	[illegible]	27,346	27,556
c. Cash in Hand	15	24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,164
Total Current Assets			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	181,756
2. Current Liabilities										
a. Accounts Payable	30	12	[illegible]	15,43[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3. Working Capital										
a. Net Working Capital			[illegible]	104,454	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
b. Increase in Working Capital			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4,447	[illegible]
4. Total Production Costs			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Less : Raw Materials			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
: Utilities			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
: Depreciation			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	14,977
			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5. Required Cash Balance	15	24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

	2003	2004	2005	2006	2007	2008	2009
1. Current Assets							
a. Accounts Receivable	28,821	[illegible]	[illegible]	[illegible]	[illegible]	33,006	[illegible]
b. Inventory:							
- Local Materials	[illegible]	[illegible]	[illegible]	[illegible]	0	0	[illegible]
- Imported Materials	95,345	95,676	[illegible]	106,466	[illegible]	[illegible]	110,991
- Spare Parts	1,994	2,094	2,196	[illegible]	2,414	2,545	2,672
- Work-in-Progress	28,885	[illegible]	29,570	30,452	[illegible]	30,984	31,279
Finished Products	[illegible]	[illegible]	[illegible]	31,267	[illegible]	31,816	32,113
c. Cash in Hand	2,186	2,246	2,275	[illegible]	2,346	2,367	[illegible]
Total Current Assets	[illegible]	184,205	[illegible]	207,262	[illegible]	210,813	212,707
2. Current Liabilities							
a. Accounts Payable	[illegible]	[illegible]	[illegible]	27,81[illegible]	[illegible]	[illegible]	[illegible]
3. Working Capital							
a. Net Working Capital	158,451	159,569	174,259	179,449	[illegible]	182,537	184,256
b. Increase in Working Capital	[illegible]	1,136	[illegible]	5,161	1,513	1,575	1,721
4. Total Production Costs	360,634	363,376	393,408	[illegible]	[illegible]	411,096	414,946
Less : Raw Materials	[illegible]	287,628	315,616	325,396	[illegible]	[illegible]	[illegible]
: Utilities	7,519	7,769	8,085	8,410	[illegible]	9,035	9,372
: Depreciation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	14,977	14,977
	[illegible]	53,00[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5. Required Cash Balance	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Accounts Receivable : [illegible] days [illegible] operating costs (production costs minus depreciation and interest)
Work-in-Progress : 30 days [illegible] factory costs
Finished Products : [illegible] days [illegible] factory costs plus admin. [illegible] overheads
Cash in Hand : 15 days [illegible] production costs (less raw materials, utilities and depreciation)
Accounts Payable : 30 days [illegible] raw materials and utilities

Appendix 11.4

UNITED PENICILLIN PROJECT ([illegible])

CALCULATION OF WORKING CAPITAL

in Pesos '000

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Raw Materials															
Local Materials	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	0	0	0	[illegible]	[illegible]	0
Imported Material	111,[illegible]	[illegible]	[illegible]	237,382	[illegible]	[illegible]74,049	281,[illegible]	284,36[illegible]	285,88[illegible]	287,628	315,416	325,398	327,[illegible]	33[illegible]	332,972
Direct Labour	7,540	7,540	7,540	7,540	7,540	7,540	7,540	7,540	7,540	7,540	7,540	7,540	7,540	7,540	7,540
Utilities	[illegible]	[illegible]	4,54[illegible]	5,591	[illegible]789	6,629	7,1[illegible]	7,316	7,519	7,769	8,085	8,41[illegible]	8,7[illegible]	9,035	9,372
Replacement Spare Parts	[illegible]	[illegible]	[illegible]	3,1[illegible]	[illegible]	3,445	3,6[illegible]	3,798	3,988	4,187	4,396	4,616	4,84[illegible]	5,08[illegible]	5,342
Repairs & Maintenance	[illegible]	[illegible]	[illegible]	10,21[illegible]	[illegible]739	11,955	12,4[illegible]	12,564	12,70[illegible]	12,854	14,020	14,484	14,681	14,887	15,13[illegible]
Factory Overhead Costs	4,980	4,980	4,980	4,980	4,980	4,980	4,980	4,980	4,980	4,980	4,980	4,980	4,980	4,980	4,980
1. Total Factory Costs	125,545	[illegible]	[illegible]	266,8[illegible]	275,32[illegible]	[illegible]6,635	316,136	[illegible]	[illegible]	324,556	354,637	365,42[illegible]	368,559	371,80[illegible]	375,34[illegible]
Administrative Overheads	10,015	[illegible]	10,015	10,015	10,015	10,015	10,015	10,015	10,015	10,015	10,015	10,015	10,015	10,015	10,015
Sales & Distribution Cost	[illegible]	10,22[illegible]	10,6[illegible]	11,271	11,45[illegible]	11,657	12,8[illegible]	13,041	13,222	13,4[illegible]	13,67[illegible]	13,84[illegible]	14,0[illegible]	14,296	14,611
2. Operating Costs	154,9[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	331,5[illegible]	341,[illegible]	342,6[illegible]	345,8[illegible]	34[illegible]	378,4[illegible]	389,2[illegible]	[illegible]	[illegible]	[illegible]
Financial Costs	25,21[illegible]	[illegible]	25,41[illegible]	15,66[illegible]	[illegible]	[illegible]52[illegible]			0	0	0	[illegible]	[illegible]	0	0
Depreciation	60,16[illegible]	[illegible]	[illegible]	[illegible]166	[illegible]	14,97[illegible]	14,9[illegible]	14,977	14,977	14,977	14,97[illegible]	14,977	14,977	14,977	14,977
3. Total Production Costs	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]634	[illegible]	393,466	404,26[illegible]	[illegible]	411,[illegible]	414,946

APPENDIX 11-4

CALCULATION OF WORKING CAPITAL : OPTION B

1. Calculation of Working Capital Requirement

1.1 The provisions made in respect of total current assets and current liabilities have been calculated by reference to the following minimum requirements :

Accounts Receivable	:	30 days x operating costs
Inventory		
- Local Materials	:	10 days x cost of materials
- Imported Materials	:	120 days x cost of materials
- Spare Parts	:	180 days x cost of spare parts
- Work-in-Progress	:	30 days x factory costs
- Finished Products	:	30 days x factory costs plus administrative overheads
Cash in Hand	:	15 days x production costs less raw materials, utilities and depreciation
Accounts Payable	:	30 days x cost of raw materials plus utilities

1.2 The difference between total current assets and current liabilities represents the net working capital requirement in each year.

1.3 The total initial investment costs of the project include provision for the net working capital requirement in 1997, given that the plant would then be operating at 71% capacity utilisation.

2. Total Production Costs

2.1 The figures quoted in respect of total factory costs, administrative overheads, sales and distribution costs, financial costs and depreciation have been taken directly from the detailed production cost schedule presented at Appendix 11-8b.

UNIDO PENICILLIN PROJECT : OPTION [illegible]

TOTAL INVESTMENT COST SCHEDULE : 1993 - 2009

Appendix II-5

in Pesos '000

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1. Initial Investment Costs																	
- Foreign Currency	1[illegible],33[illegible]	126,[illegible]2	[illegible],98[illegible]				0	0	0	0	0	0	0	0	0	0	0
- Local Currency	[illegible]	95,[illegible]	785	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	40,04[illegible]	221,91[illegible]	9,7[illegible]	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement Investment																	
- Foreign Currency	0	0	0		0	0		0	0		0	0		0		0	0
- Local Currency		0			0	0	0	[illegible],530	0	0	0	0	16,940	0	0	0	0
- Total		0					0	6,930	0	0	0	0	16,940	0	0	0	0
2. Preproduction Expenditure																	
- Foreign Currency	1[illegible]3,9[illegible]8	[illegible]	0			0		0		0	0	0	0	0	0	0	0
- Local Currency	3,230	15,776	0		0		0	0	0	0	0	0	0	0	0	0	0
- Total	1[illegible]7,138	117,964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3. Working Capital Increase	0	0	60,6[illegible]4	25,8[illegible]	14,6[illegible]	4,0[illegible]	2,65[illegible]	15,66[illegible]	4,44[illegible]	1,1[illegible]	1,0[illegible]	1,13[illegible]	14,6[illegible]	5,16[illegible]	1,51[illegible]	1,575	1,721
Total Investment Costs	152,76[illegible]	339,66[illegible]	76,7[illegible]	25,8[illegible]	14,[illegible]	4,[illegible]	2,65[illegible]	15,66[illegible]	4,447	1,187	1,0[illegible]	1,13[illegible]	14,6[illegible]	5,161	1,51[illegible]	1,575	1,721

APPENDIX 11-5

TOTAL INVESTMENT COST SCHEDULE : OPTION B

1. Initial and Replacement Investment Costs

1.1 The figures quoted in respect of initial investment costs have been taken directly from the cost schedule presented at Appendix 11-2.

1.2 It has been assumed that the project vehicles would be replaced in the year 2000 and again in 2005, and that the service equipment would also be replaced 2005.

2. Pre-Production Expenditure

2.1 The figures quoted in respect of pre-production capital expenditure have been taken directly from the expenditure schedule presented at Appendix 11-3.

3. Working Capital Increase

3.1 The figures quoted in respect of the increase in the net working capital requirement in each year have been taken directly from the working capital schedule presented at Appendix 11-4.

UNIDO PENICILLIN PROJECT : OPTION [illegible]

TOTAL ASSETS SCHEDULE : 199[illegible] - 20[illegible]

Appendix [illegible]

in Pesos '000

Year	199[illegible]	1994	1995	199[illegible]	199[illegible]	199[illegible]	199[illegible]	2[illegible]	2[illegible]	200[illegible]	2003	200[illegible]	2005	200[illegible]	200[illegible]	2008	2009
1. Initial investment costs																	
- Foreign Currency	15,[illegible]	1,6[illegible]	6,[illegible]							0	0						
- Local currency	[illegible],36[illegible]	95,[illegible]	735		0		0	0	0	0						0	0
- Total	[illegible]	[illegible]	[illegible]								0			0	0	0	
Replacement Investment																	
- Foreign currency																	
- Local Currency	0				0			[illegible],97[illegible]					1[illegible],94[illegible]				
- Total								[illegible],97[illegible]	0				1[illegible],94[illegible]			0	
2. Preproduction expenditure																	
- Foreign Currency	1[illegible],9[illegible]	1[illegible],16[illegible]						0		0	0						
- Local Currency	[illegible],23[illegible]	15,776							0	0	0						0
- Total	1[illegible],1[illegible]8	11[illegible],9[illegible]4			0		0	0			0						0
3. Current assets increase	0	0	[illegible],24[illegible]	41,[illegible]	[illegible]	[illegible],7[illegible]	3,364	16,4[illegible]	5,1[illegible]	1,[illegible]	1,14[illegible]	1,30[illegible]	17,055	[illegible],0[illegible]	1,[illegible]	1,806	1,974
Total assets	[illegible]53,[illegible]	[illegible],6[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3,364	25,4[illegible]	5,17[illegible]	1,362	1,142	1,[illegible]04	33,995	[illegible],0[illegible]	1,779	1,806	1,974

APPENDIX 11-6

TOTAL ASSETS SCHEDULE : OPTION B

1. Initial and Replacement Investment Costs

1.1 The figures quoted in respect of initial investment costs have been taken directly from the cost schedule presented at Appendix 11-2.

1.2 The figures quoted in respect of replacement investment have been taken directly from the cost schedule presented at Appendix 11-5.

2. Pre-Production Expenditure

2.1 The figures quoted in respect of pre-production capital expenditure have been taken directly from the expenditure schedule presented at Appendix 11-3.

3. Current Assets Increase

3.1 The figures quoted in respect of the increase in current assets in each year have been calculated by reference to the working capital schedule detailed in Appendix 11-4.

3.2 The total initial assets of the project include provision for the total current assets figure in 1997, given that the plant would then be operating at 71% capacity utilisation.

UNITED PENICILLIN PROJECT : OPTION B

INITIAL FINANCING PLAN

Appendix 11-7

In Pesos '000

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1. Equity Subscription																	
- Promoters	155,4[illegible]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Financial Institutions	104,325	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Foreign Currency Loans	18,921	228,417	57,695		0	0	0	0	0	0	0	0	0	0	0	0	0
3. Local Currency Loans			0	55,475	0	0		0	0	0	0	0	0	0	0	0	0
4. Current Liabilities	0	0	9,641	5,75[illegible]	4,068	72[illegible]	526	2,637	72[illegible]	175	142	166	2,3[illegible]6	815	226	233	253
Total	27[illegible],727	228,413	77,53[illegible]	61,226	4,068	72[illegible]	526	2,637	726	175	142	166	2,376	815	226	233	253

APPENDIX 11-7

INITIAL FINANCING PLAN : OPTION B

1. Equity Subscription

1.1 It has been assumed that both the local promoters and those financial institutions invited to participate in the project would subscribe for their shares in full during 1993, and would therefore take up their respective shareholdings of 60% and 40% at the outset.

1.2 It may be noted that this would ensure that the project had sufficient funds in hand to cover anticipated expenditure on local investment items, including working capital, during the implementation phase and the first year of operations.

2. Foreign Currency Loans

2.1 It has been assumed that the foreign currency loans would be drawndown in three tranches as follows :

1993	:	P 18,921,000	=	6.0%
1994	:	P 228,413,000	=	72.5%
1995	:	P 67,895,000	=	21.5%
		P 315,229,000		

2.2 It may be noted that this would ensure that the project had sufficient funds in hand to cover anticipated expenditure on imported investment items, including working capital, during both the implementation phase and the 3-year build-up to 71% capacity utilisation in 1997.

3. Local Currency Loans

3.1 It has been assumed that the local currency loans would be drawndown in their entirety in 1996, and would therefore be used to fund the balance of the working capital requirement of the project.

4. Current Liabilities

4.1 The figures quoted in respect of the increase in current liabilities in each year have been calculated by reference to the working capital schedule detailed in Appendix 11-4.

UNIDO PENICILLIN PROJECT : OPTION [illegible]

PRODUCTION COST SCHEDULE

Appendix II-8a

in Pesos '000

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1. Direct Materials & Inputs	115,695	185,191	[illegible]	[illegible]	[illegible]	[illegible]	289,601	291,598	293,405	295,397	322,901	323,848	330,511	334,306	340,344
2. Direct Manpower	7,54	7,54	7,54	7,54	[illegible]	7,540	7,540	7,540	7,540	7,540	7,540	7,540	7,540	7,540	7,540
3. Factory Overheads	[illegible]	15,3[illegible]	[illegible]	18,[illegible]	19,[illegible]	[illegible]	20,997	21,241	21,675	22,021	23,396	24,680	24,508	24,956	25,454
Factory Costs	135,545	[illegible]	253,357	[illegible]	275,8[illegible]	306,676	318,136	320,586	322,620	324,958	354,837	365,426	368,559	371,892	375,343
4. Administrative Overheads	10,015	10,015	10,015	10,015	10,015	10,015	10,015	10,015	10,015	10,015	10,015	10,015	10,015	10,015	10,015
5. Sales & Distribution Cost	9,376	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12,041	[illegible]	13,426	13,63[illegible]	13,843	14,09[illegible]	14,396	14,611
Operating Costs	154,936	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	341,024	34[illegible]	345,857	348,398	378,491	389,266	392,666	396,117	399,969
6. Financial Costs	25,216	32,615	29,417	19,[illegible]	9,419	2,52[illegible]	0	0	0	0	0	0	0	0	0
7. Depreciation	60,165	60,165	60,165	60,165	60,1[illegible]	14,977	14,977	14,977	14,977	14,977	14,977	14,977	14,977	14,977	14,977
Total Production Cost	240,32[illegible]	325,294	[illegible]	[illegible]	[illegible]	349,019	356,001	358,612	360,834	363,376	393,469	404,263	407,643	411,090	414,946

UNIDO PENICILLIN PROJECT : OPTION E

DETAILED PRODUCTION COST SCHEDULE

Appendix 11-6b

in Pesos (000)

Year		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2001	[illegible]	2003	2004	2005	2006	[illegible]	[illegible]	[illegible]
1.1 Direct Materials																
Fermentation Materials	- Imported	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	0	[illegible]	0	0	0	[illegible]	0	0	[illegible]
	- Local	0	[illegible]	[illegible]	0	0	[illegible]	[illegible]	0	0	0	0	[illegible]	0	[illegible]	0
Extraction Materials	- Imported	[illegible]	0	0	0	0	0	0	0	0	0	0	[illegible]	0	[illegible]	0
6-APA Production	- Imported	[illegible]	[illegible]	[illegible]	[illegible]	201,2[illegible]	[illegible],264	237,060	237,060	237,060	237,060	[illegible]3,553	270,560	[illegible]	270,560	270,560
Bulk Ampicillin	- Imported	7,42[illegible]	4,644	[illegible]	[illegible]	7,061	7,061	7,061	[illegible],509	6,368	6,368	5,694	5,694	5,605	5,605	4,932
Bulk Amoxicillin	- Imported	[illegible],915	[illegible],59[illegible]	17,69[illegible]	[illegible],243	[illegible]	28,3[illegible]	29,51[illegible]	31,362	32,869	34,407	35,792	37,36[illegible]	39,577	41,091	42,309
Bulk Cloxacillin	- Imported	[illegible]	1,55[illegible]	[illegible],443	[illegible]	4,146	4,146	4,146	4,96[illegible]	4,946	4,946	5,77[illegible]	6,536	6,647	7,407	6,260
Final Dosage Form	- Imported	[illegible]	1,6[illegible]	[illegible]	[illegible]	3,94[illegible]	4,165	4,321	4,545	4,627	4,847	5,004	5,226	5,385	5,606	5,911
		11[illegible]	[illegible]	[illegible]	[illegible]	2[illegible]2,59[illegible]	[illegible]	2[illegible]1,50[illegible]	284,362	285,686	287,625	315,816	325,798	[illegible],774	330,271	332,972
1.2 Utilities																
Fermentation Extraction		[illegible]			[illegible]		[illegible]	[illegible]	0	0	[illegible]	0	[illegible]	[illegible]	0	0
6-APA Production		[illegible]	[illegible]	[illegible]	768	[illegible]	8[illegible]	899	899	899	899	1,0[illegible]	1,030	1,030	1,030	1,030
Bulk Ampicillin		424	[illegible]	[illegible]	672	66[illegible]	66[illegible]	86[illegible]	[illegible]	791	791	[illegible]	709	701	701	619
Bulk Amoxicillin		93[illegible]	1,48[illegible]	[illegible]	[illegible]	[illegible]	3,342	3,521	[illegible]	3,871	4,051	4,222	4,401	4,6[illegible]	4,841	5,162
Bulk Cloxacillin		[illegible]	[illegible]	154	[illegible]	[illegible]	26[illegible]	[illegible]	[illegible]	313	313	366	415	415	466	521
Final Dosage Form		23[illegible]	595	84[illegible]	1,1[illegible]	1,4[illegible]	1,47[illegible]	1,54[illegible]	1,61[illegible]	1,645	1,715	1,785	1,855	1,925	1,995	[illegible]
		[illegible]	[illegible]	4,549	5,591	[illegible]	[illegible]	7,1[illegible]	[illegible]	7,519	7,769	8,085	8,41[illegible]	[illegible]	9,035	[illegible]
2. Direct Manpower		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7,540	7,540	7,540	7,540	[illegible]
3. Factory Overheads																
Manpower		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3,68[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3,68[illegible]	3,68[illegible]
Replacement Spare Parts		[illegible]	2,874	[illegible]	3,125	3,261	3,445	3,61[illegible]	[illegible]	3,988	4,187	4,39[illegible]	4,61[illegible]	4,847	5,089	5,347
Repairs & Maintenance		4,[illegible]	7,5[illegible]	[illegible]	[illegible]	[illegible]	11,9[illegible]	12,4[illegible]	12,564	12,707	[illegible],654	14,02[illegible]	14,464	14,6[illegible]	14,667	15,13[illegible]
Protective Clothing, etc		[illegible]	[illegible]	[illegible]	1,3[illegible]	[illegible]	[illegible]	1,30[illegible]	[illegible]	1,30[illegible]	1,30[illegible]	1,30[illegible]	1,300	[illegible]	1,300	1,300
		[illegible]	15,[illegible]	[illegible]	15,[illegible]	[illegible]	[illegible]	20,9[illegible]	[illegible]	[illegible]	[illegible]	23,39[illegible]	24,08[illegible]	24,5[illegible]	24,956	[illegible],459
4. Administrative Overheads																
Manpower		5,0[illegible]	[illegible]	5,0[illegible]	[illegible]	[illegible]	5,05	5,05[illegible]	[illegible]	5,05[illegible]	5,05[illegible]	5,05[illegible]	5,05[illegible]	[illegible]	5,05[illegible]	5,05[illegible]
Insurance		2,68[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,68[illegible]	2,68[illegible]	2,687	2,68[illegible]	[illegible]	2,68[illegible]	[illegible]
Office Supplies		65[illegible]	65[illegible]	[illegible]	65[illegible]	65	[illegible]	65[illegible]	[illegible]	65[illegible]	65[illegible]	65[illegible]	[illegible]	65	65[illegible]	[illegible]
Communications		65[illegible]	65[illegible]	65[illegible]	65[illegible]	65[illegible]	65[illegible]	650	650	65[illegible]	65[illegible]	65[illegible]	650	650	650	650
Land/Property Charges		156	15[illegible]	15[illegible]	15[illegible]	15[illegible]	156	15[illegible]	15[illegible]	15[illegible]	156	156	15[illegible]	15[illegible]	15[illegible]	15[illegible]
Technology Transfer		0	0	0	[illegible]	[illegible]	0	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	0	0	0
Licences & Fees		13[illegible]	13[illegible]	13[illegible]	13[illegible]	13[illegible]	13[illegible]	13[illegible]	13[illegible]	13[illegible]	13[illegible]	13[illegible]	13[illegible]	130	130	13[illegible]
Travel & Transport		4[illegible]	4[illegible]	4[illegible]	4[illegible]	4[illegible]	4[illegible]	4[illegible]	4[illegible]	400	4[illegible]	4[illegible]	4[illegible]	4[illegible]	4[illegible]	4[illegible]
Sundries		29[illegible]	29[illegible]	29[illegible]	29[illegible]	[illegible]	29[illegible]	29[illegible]	29[illegible]	29[illegible]	29[illegible]	29[illegible]	29[illegible]	29[illegible]	29[illegible]	29[illegible]
		[illegible]	[illegible]	16,01[illegible]	1[illegible],[illegible]15	[illegible]	[illegible]	[illegible]	[illegible]	16,015	16,01[illegible]	16,015	16,01[illegible]	[illegible]	16,015	16,01[illegible]

DETAILED PRODUCTION COST SCHEDULE Continued

in Pesos 000

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
5. Sales & Distribution Costs															
Manpower	[illegible]	[illegible]	[illegible]	6,265	[illegible]	[illegible]	6,265	6,265	6,265	6,265	6,265	6,265	6,265	6,265	6,285
Product Promotion	1,469	2,03[illegible]	2,47[illegible]	2,999	3,526	3,667	3,799	3,912	4,033	4,169	4,311	4,447	4,61[illegible]	4,749	4,959
Travel	[illegible]	620	[illegible]	[illegible]	620	620	620	620	620	620	620	620	[illegible]	620	620
Office Rental	750	75	75[illegible]	750	750	750	75	750	750	750	75[illegible]	750	750	750	750
Sales Commissions	251	575	753	1,017	1,281	1,349	1,4[illegible]	1,474	1,534	1,662	1,677	1,741	1,814	1,85[illegible]	1,997
	[illegible]	[illegible]	[illegible]	[illegible]	12,452	12,667	12,67[illegible]	17,641	[illegible]	[illegible]	[illegible]	13,647	14,[illegible]	14,25[illegible]	14,611
6. Financial Costs															
Foreign Currency Loans	[illegible],116	[illegible]	[illegible]	12,[illegible]	[illegible]	[illegible]			0		0	0		0	0
Local Currency Loans		14,[illegible]	[illegible]	7,059	[illegible],352			0		0	0				0
	25,116	36,815	25,417	19,6[illegible]	5,919	1,522			0	0	0				0
7. Depreciation															
Buildings	5,643	5,643	5,643	5,643	5,643	5,843	5,643	5,643	5,643	5,643	5,643	5,643	5,643	5,643	5,643
Plant, Machinery & Equipment	6,747	6,747	6,747	6,747	6,747	6,747	6,747	6,747	6,747	6,747	6,747	6,747	6,747	6,747	6,747
Vehicles	1,386	1,386	1,386	1,386	1,386	1,386	1,386	1,386	1,386	1,386	1,386	1,386	1,386	1,386	1,386
Service Equipment	1,001	1,001	1,001	1,001	1,001	1,001	1,001	1,001	1,001	1,001	1,001	1,001	1,001	1,001	1,001
Intangibles	45,191	45,1[illegible]	45,191	45,191	45,194	0		0	0			0			0
	[illegible],166	[illegible]	[illegible]	[illegible]	[illegible]	14,977	14,977	14,977	14,977	14,977	14,977	14,977	14,977	14,977	14,977
Total Production Cost	[illegible]	[illegible]	[illegible]	[illegible]	366,265	349,01[illegible]	356,0[illegible]	356,317	360,674	363,376	393,466	404,263	40[illegible]	411,05[illegible]	414,946

APPENDIX 11-8

PRODUCTION COST SCHEDULE : OPTION B

1. Direct Materials and Inputs

1.1 Expenditure on raw material inputs has been calculated by reference to the detailed production schedule presented at Appendix 3-30, and the following usage and cost figures :

6-APA

Imported Production Materials	kg/tonne	cost/tonne
- Penicillin	185,000	$ 25,000
- Dichloromethane	6,000	$ 905
- Ammonia	1,500	$ 190
- Hydrochloric Acid 30%	2,000	$ 90
- Acetone	2,500	$ 1,200

Ampicillin

Imported Production Materials	kg/tonne	cost/tonne
- Acetone	680	$ 1,200
- Dichloromethane	960	$ 905
- Methyl Iso Butyl Ketone	400	$ 1,560
- Triethylamine	340	$ 3,895
- Ethylchlorocarbonate	372	$ 17,400
- Phenylglycine	491	$ 25,600
- Potassium Hydroxide	172	$ 4,870
- Ethanol	156	$ 1,182
- Ethylacetoacetate	440	$ 3,270

Amoxycillin

Imported Production Materials	kg/tonne	cost/tonne
- Acetone	700	$ 1,200
- Dichloromethane	960	$ 905
- Methyl Iso Butyl Ketone	400	$ 1,560
- Triethylamine	330	$ 3,895
- Ethylchlorocarbonate	360	$ 17,400
- Phenylglycine	551	$ 25,600
- Potassium Hydroxide	183	$ 4,870
- Ethanol	166	$ 1,182
- Ethylacetoacetate	470	$ 3,270

Cloxacillin

Imported Production Materials	kg/tonne	cost/tonne
- Acetone	1,250	$ 1,200
- Methyl Iso Butyl Ketone	2,500	$ 1,560
- Acid Chloride	714	$ 21,000
- Sodium Hydroxide	116	$ 9,660
- Sodium Hexanoate	480	$ 16,365

Final Dosage Forms

	% of sales	cost/tonne
Imported Packaging Materials		
- Capsules	70%	$ 30,129
- Syrups	30%	$ 56,000

1.2 It may be noted that all raw material costs are quoted per tonne of active ingredient, delivered to the factory site. In the case of imported materials, provision has also been made in the cost for payment of 10% customs duties.

1.3 Expenditure on utilities has been calculated by reference to the detailed production schedule presented at Appendix 3-30, and the following usage and cost figures :

	cost/tonne of product
6-APA	P 5,450
Ampicillin	P 81,500
Amoxycillin	P 81,500
Cloxacillin	P 48,200
Final Dosage Forms	P 350,000

2. **Direct Manpower**

2.1 The wage and salary cost of the production staff employed in the factory has been estimated at a total of just over P 7.5 million per annum. This figure may be broken down as follows :

	Number	Salary	Annual Cost
Direct Production Staff			
- Production Supervisors	13	180,000	2,340,000
- Technicians	22	120,000	2,640,000
- Skilled Workers	24	80,000	1,920,000
- Unskilled Labour	16	40,000	640,000
Total	75		7,540,000

3. **Factory Overheads**

3.1 The wage and salary cost of the laboratory and engineering staff employed in the factory has been estimated at a total of P 3.7 million per annum. This figure may be broken down as follows :

	Number	Salary	Annual Cost
Laboratory/Engineering Staff			
- Supervisors	8	180,000	1,440,000
- Technicians	12	120,000	1,440,000
- Skilled Workers	8	80,000	640,000
- Unskilled Labour	4	40,000	160,000
Total	32		3,680,000

3.2 The provision made for the importation of replacement spare parts has been calculated at 2% of the initial value of the production/auxiliary machinery and equipment to be installed in the factory. However, this figure has been projected to rise at a compound growth rate of 5% per annum to cover the expected increase in servicing needs over time.

3.3 The provision made for repairs and maintenance has been calculated at the rate of 3% by reference to projected sales revenues in each year.

3.4 Additional provision has been made for annual expenditures totalling P 1.3 million on protective clothing and sundry other consumables such as cleaning materials, lubricants and loose tools used within the factory complex.

4. Administrative Overheads

4.1 The wage and salary cost of the senior management team and the administration and other personnel employed has been estimated at a total of P 5.05 million per annum. This figure may be broken down as follows :

	Number	Salary	Annual Cost
Senior Management			
- Chief Executive	1	800,000	800,000
- Directors	2	500,000	1,000,000
- Production/Lab/Engineering	5	250,000	1,250,000
- Commercial/Administration	2	250,000	500,000
Administration/Other Personnel			
- Accounts Officer	1	120,000	120,000
- Storekeepers	4	60,000	240,000
- Secretaries	4	60,000	240,000
- Security Officers	2	60,000	120,000
- Clerical Staff	8	40,000	320,000
- Drivers	5	40,000	200,000
- Receptionists	2	30,000	60,000
- Watchmen	8	25,000	200,000
Total	44		5,050,000

4.2 The cost of insuring the factory and other buildings, plus all the plant, machinery and equipment installed therein and the project vehicles, against fire, theft and accidental damage has been estimated at 1% of the initial value of the assets. The figure quoted of approximately P 2.7 million should also include the cost of providing accident cover for the workforce.

4.3 Various provisions totalling just under P 2 million have been specified to cover annual expenditures on office supplies, communications, land/property charges, licences, fees and travel/transport.

4.4 Finally, provision has been made for what is, in effect, a contingency allowance, calculated at 3% of total overhead costs, to cover those items which have not been separately specified (such as donations, entertainment, staff medical and canteen expenses and the like).

5. Sales and Distribution Costs

5.1 The wage and salary cost of the sales and distribution team employed both within the factory complex and in the field has been estimated at a total of just under P 6.3 million per annum. This figure may be broken down as follows :

	Number	Salary	Annual Cost
Management			
- Sales Directors	2	500,000	1,000,000
- Sales Managers	2	250,000	500,000
Other Personnel			
- Salesman (Pen-G & 6-APA)	1	180,000	180,000
- Sales Supervisors	3	180,000	540,000
- Sales Representatives	25	144,000	3,600,000
- Sales Administrator	1	120,000	120,000
- Senior Secretary	1	60,000	60,000
- Secretaries	4	35,000	140,000
- Clerical Staff	4	30,000	120,000
- Receptionist	1	25,000	25,000
Total	44		6,285,000

5.2 The figures quoted in respect of product promotion, travel and transport, office rental and sales commissions have been taken directly from the detailed cost schedule presented at Appendix 3-28 (Option B refers).

6. Financial Costs

6.1 It has been assumed that the foreign currency loans would be made available on the basis of the following terms and conditions :

Loan Amount	:	P 315,229,000, equivalent to just over $ 12.1 million.
Loan Term	:	6 years, inclusive of a grace period of one year.
Loan Drawdown	:	final tranche drawn by mid-1995.
Interest Rate	:	8% per annum, payable on the balance outstanding.
Repayment	:	in five equal annual instalments, commencing one year after final drawdown (that is, by mid-1996).

6.2 It has been assumed that the local currency loans would be made available on the basis of the following terms and conditions :

Loan Amount	:	P 56,475,000, equivalent to just under $ 2.8 million.
Loan Term	:	4 years, inclusive of a grace period of one year.
Loan Drawdown	:	by mid-1996.
Interest Rate	:	25% per annum, payable on the balance outstanding.
Repayment	:	in three equal annual instalments, commencing one year after drawdown (that is, by mid-1997).

7. Depreciation

7.1 Depreciation in respect of the proposed investment has been calculated on a straight line basis in accordance with the following rates :

Buildings and Civil Works	:	5%
Auxiliary and Service Facilities	:	5%
Production Equipment	:	5%
Ancillary Production Equipment	:	5%
Auxiliary Equipment	:	5%
Vehicles	:	20%
Service Equipment	:	10%
Intangibles *	:	20%

* incorporated fixed assets and pre-production capital expenditure

UNIDO PENICILLIN PROJECT : OPTION E

Appendix 11-9

NET INCOME STATEMENT

In Pesos 000

Year	1995	1996	1997	1998	1999	2000	2001	2002
1. Sales Revenues	154,35[illegible]	25[illegible],61[illegible]	[illegible],244	340,[illegible]	35[illegible],96[illegible]	3[illegible]9,830	413,336	418,841
2. Operating Costs	154,9[illegible]	228,311	23[illegible],24[illegible]	[illegible]	29[illegible],29[illegible]	331,55[illegible]	341,6[illegible]	343,6[illegible]
3. Operating Profit (Loss)	[illegible]	[illegible]	[illegible]	4[illegible],5[illegible]	5[illegible],6[illegible]	[illegible]	[illegible]	75,1[illegible]
4. Financial Costs	[illegible]	2[illegible],615	[illegible]	14,[illegible]	[illegible]	[illegible],5[illegible]	[illegible]	[illegible]
5. Depreciation	[illegible]86	[illegible]	[illegible]	[illegible]	[illegible]	14,97[illegible]	14,977	14,97[illegible]
Gross Profit (Loss) before Tax	(35,9[illegible])	(74,475)	(45,598)	(29,95[illegible])	(10,42[illegible])	58,811	57,737	60,166
Corporate Taxation				[illegible]	0	0	20,[illegible]8	21,0[illegible]
8. Net Profit/(Loss)	(35,9[illegible])	(74,475)	(45,598)	(29,95[illegible])	(10,42[illegible])	58,811	37,[illegible]69	39,12[illegible]
9. Dividends	0	0	0	0	0	0	0	0
10. Retained Profits	(35,9[illegible])	(74,475)	(45,598)	(29,95[illegible])	(10,42[illegible])	58,811	37,[illegible]69	39,12[illegible]
11. Revenue Reserves	55,[illegible]	(150,44[illegible])	(21[illegible],[illegible]9)	(239,9[illegible])	(250,40[illegible])	(199,595)	(162,3[illegible])	(123,204)
Gross Profit : Sales	-55.[illegible]%	-29.[illegible]%	-15.5%	-8.6%	-2.[illegible]%	12.[illegible]%	13.9%	14.4%
Net Profit : Equit	-33.0%	-26.6%	-15.0%	-11.5%	-4.0%	19.3%	14.3%	15.0%

Year	2003	2004	2005	2006	2007	2008	2009
1. Sales Revenues	42[illegible],5[illegible]4	428,46[illegible]	457,33[illegible]	482,8[illegible]4	48[illegible],3[illegible]3	49[illegible],22[illegible]	504,535
2. Operating Costs	345,857	348,3[illegible]	376,491	389,26[illegible]	[illegible]	396,11[illegible]	399,969
3. Operating Profit (Loss)	[illegible]	80,0[illegible]	88,84[illegible]	93,518	96,6[illegible]	100,11[illegible]	104,56[illegible]
4. Financial Costs			0	0	0	0	0
5. Depreciation	14,97[illegible]	14,977	14,97[illegible]	14,977	14,977	14,977	14,977
Gross Profit (Loss) before Tax	62,730	65,084	73,865	76,541	81,7[illegible]	85,133	89,569
Corporate Taxation	21,95[illegible]	22,779	25,85[illegible]	27,469	28,6[illegible]	29,79[illegible]	31,336
8. Net Profit/(Loss)	40,774	42,305	48,01[illegible]	51,052	53,116	55,336	58,233
9. Dividends	0	0	0	0	42,494	44,2[illegible]	46,586
10. Retained Profits	40,774	42,305	48,01[illegible]	51,052	1[illegible],6[illegible]4	11,0[illegible]	11,647
11. Revenue Reserves	(82,430)	(40,125)	7,887	58,[illegible]	69,5[illegible]3	80,63[illegible]	92,27[illegible]
Gross Profit : Sales	14.8%	15.2%	15.8%	16.3%	16.7%	17.2%	17.8%
Net Profit : Equit	15.6%	16.2%	18.4%	19.6%	20.4%	21.2%	22.3%

APPENDIX 11-9

NET INCOME STATEMENT : OPTION B

1. Sales Revenues

1.1 The figures quoted in respect of sales revenues have been taken directly from the detailed schedules presented at Appendices 3-26 and 3-27 (Option B refers).

2. Operating Costs, Financial Costs and Depreciation

2.1 The figures quoted in respect of operating costs, financial costs and depreciation have all been taken directly from the production cost schedule presented at Appendix 11-8a.

3. Taxation

3.1 It has been assumed that the project would be successful in negotiating an initial tax holiday of six years from the commencement of commercial operations. Thereafter corporate tax would become payable at the normal rate of 35%.

3.2 It may be noted that, in terms of the fiscal regulations in the Philippines, the losses made during the tax holiday period cannot be carried forward and offset against future profits.

4. Dividends

4.1 Provision has been made for the project to declare dividends to a maximum of 80% of profits after tax once sufficient cash reserves have been established to sustain these.

5. Revenue Reserves

5.1 The revenue reserves reflect the accumulated profit position of the project, and the changes thereto, as reflected in the income statement and final profit or loss figures for each year.

AIEC PENICILLIN PROJECT : OPTION 3

CASH FLOW TABLE FOR FINANCIAL PLANNING

Appendix 11-1

In Pesos 000

YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001
CASH INFLOW	279,73[illegible]	226,417	231,692	21[illegible]	224,2[illegible]	341,1[illegible]	358,491	40[illegible],467	414,[illegible]4
1. Financial Resources	[illegible]	22[illegible],413	7[illegible],53[illegible]	[illegible]	4,08[illegible]	7[illegible]	5[illegible]	[illegible],63[illegible]	72[illegible]
2. Sales Revenue	-		154,[illegible]	[illegible]	[illegible]	34[illegible]	[illegible]	3[illegible],57[illegible]	[illegible]
CASH OUTFLOW	153,7[illegible]	2[illegible],63[illegible]	([illegible])	([illegible],614)	([illegible],2[illegible])	(3[illegible],794)	([illegible],47[illegible])	(402,51[illegible])	(3[illegible],26[illegible])
1. Total Assets Schedule	157,75[illegible]	2[illegible],867	(56,[illegible]2)	(41,64[illegible])	(26,7[illegible])	(4,7[illegible])	([illegible],2[illegible]4)	(2[illegible],4[illegible]9)	([illegible],1[illegible]3)
2. Operating Costs	0	-	(154,[illegible])	([illegible])	([illegible])	([illegible],51[illegible])	(25[illegible],[illegible])	([illegible])	([illegible])
3. Debt Service : Interest									
- Foreign Currency Loans	-		(25,215)	(22,[illegible])	(1[illegible],[illegible])	(1[illegible],[illegible])	(7,[illegible])	(2,52[illegible])	-
- Local Currency Loans		-		(14,11[illegible])	(1[illegible],765)	(7,059)	(2,253)	0	0
Debt Service : Repayments									
- Foreign Loan		-	-	(63,[illegible])	([illegible]3,04[illegible])	(53,04[illegible])	(53,04[illegible])	(53,04[illegible])	0
Local Loan	-	-	0	-	(18,525)	(16,8[illegible])	(16,8[illegible])	-	
4. Corporate Tax	0	0	0	-	0		-		([illegible])
5. Dividends	0	0		-	0		-		
SURPLUS (DEFICIT)	125,957	111,47[illegible]	(5[illegible],274)	(5[illegible],72[illegible])	(55,52[illegible])	(55,66[illegible])	(34,9[illegible])	(2[illegible],65[illegible])	47,74[illegible]
CUMULATIVE CASH SHORTFALL	125,957	14,467	(21,7[illegible])	(76,51[illegible])	(1[illegible]4,442)	(23[illegible],1[illegible])	(265,08[illegible])	(265,13[illegible])	(2[illegible],3[illegible])

YEAR	2002	2003	2004	2005	2006	2007	2008	2009
CASH INFLOW	419,97[illegible]	423,706	426,6[illegible]	4[illegible],70[illegible]	463,6[illegible]	489,569	4[illegible],456	504,786
1. Financial Resources	1[illegible]5	142	1[illegible]	2,376	6[illegible]	2[illegible]	2[illegible]	2[illegible]
2. Sales Revenue	41[illegible],[illegible]1	42[illegible],564	426,4[illegible]	467,[illegible]	48[illegible],6[illegible]	4[illegible],[illegible]	4[illegible],[illegible]	504,535
CASH OUTFLOW	(3[illegible],064)	(366,95[illegible])	(37[illegible],46[illegible])	(4[illegible],[illegible]9)	(42[illegible],[illegible])	(4[illegible])	(4[illegible],98[illegible])	(479,685)
1. Total Assets Schedule	([illegible],[illegible]2)	([illegible],14[illegible])	([illegible],[illegible]4)	([illegible],955)	([illegible],60[illegible])	(1,7[illegible])	(1,606)	(1,974)
2. Operating Costs	(3[illegible],[illegible]3[illegible])	(345,65[illegible])	(340,399)	(378,491)	(389,28[illegible])	(372,6[illegible])	(396,113)	(399,969)
3. Debt Service : Interest								
- Foreign Currency Loans		0	0	0	-	0	0	0
- Local Currency Loans	0	0	0	0	-	-	-	0
Debt Service : Repayments								
- Foreign Loan	-	-	0		-	0		0
Local Loan	-	-	0		0	-	-	0
4. Corporate Tax	(2[illegible])	(21,95[illegible])	(2[illegible],7[illegible])	(25,6[illegible])	(2[illegible],4[illegible])	(26,[illegible])	(2[illegible],7[illegible]7)	(31,35[illegible])
5. Dividends	0	-	0	0	-	(42,49[illegible])	(44,269)	(46,58[illegible])
SURPLUS (DEFICIT)	52,512	54,75[illegible]	56,144	31,37[illegible]	60,84[illegible]	24,[illegible]68	24,465	24,90[illegible]
CUMULATIVE CASH SHORTFALL	(164,424)	(1[illegible],674)	(73,53[illegible])	(42,16[illegible])	18,66[illegible]	42,7[illegible]	67,245	9[illegible],14[illegible]

APPENDIX 11-10

CASH FLOW TABLE FOR FINANCIAL PLANNING : OPTION B

1. Cash Inflow

1.1 The figures quoted in respect of financial resources have been taken directly from the initial financing plan detailed in Appendix 11-7, and reflect the sum of the subscription for equity in the project, the foreign and local currency loans drawndown and the increase in current liabilities in each year.

1.2 The figures quoted in respect of sales revenues have been taken directly from the net income statement presented at Appendix 11-9.

2. Cash Outflow

2.1 The figures quoted in respect of total assets have been taken directly from the total assets schedule detailed in Appendix 11-6, and reflect the sum of the initial investment costs, pre-production capital expenditures and the increase in current assets in each year.

2.2 The figures quoted in respect of operating costs have been taken directly from the net income statement presented at Appendix 11-9.

2.3 The figures quoted in respect of debt service have been calculated on the basis of the terms and conditions assumed for the foreign and local currency loans, as respectively detailed in sections 6.1 and 6.2 of Appendix 11-9 :

Foreign Currency Loans
Interest Rate : 8% per annum, payable on the balance outstanding.
Repayment : in five equal annual instalments, commencing one year after final drawdown (that is, by mid-1996).

Local Currency Loans
Interest Rate : 25% per annum, payable on the balance outstanding.
Repayment : in three equal annual instalments, commencing one year after drawdown (that is, by mid-1997).

2.4 The figures quoted in respect of taxation and dividends have been taken directly from the net income statement presented at Appendix 11-9.

UNIDO PENICILLIN PROJECT : OPTION B

Appendix 11-11

PROJECTED BALANCE SHEET

In Pesos 000

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
ASSETS	275,73[illegible]	508,150	5[illegible]1,5[illegible]	502,96[illegible]	471,537	41[illegible]	359,311	3[illegible]	359,959	34[illegible],344	332,510	318,83[illegible]	337,855	347,57[illegible]	356,42[illegible]	369,72[illegible]	381,62[illegible]
1. Fixed Assets																	
- Land	6,745	8,745	6,745	8,745	6,745	6,745	8,745	6,745	6,745	8,745	8,745	8,745	6,745	8,745	8,745	8,745	8,745
- Buildings	23,369	116,841	110,998	105,155	99,312	93,469	87,626	81,783	75,940	70,097	64,254	58,411	52,568	46,725	40,882	35,039	29,196
- Plant & Machinery	14,526	125,697	128,199	121,452	114,7[illegible]5	107,958	101,211	94,464	87,717	80,970	74,223	67,476	60,729	53,982	47,235	40,488	33,741
- Vehicles	0	6,930	5,544	4,158	2,772	1,386	0	5,544	4,158	2,772	1,386	0	5,544	4,158	2,772	1,386	0
- Service Equipment	0	10,010	9,009	8,008	7,007	6,006	5,005	4,004	3,003	2,002	1,001	0	9,009	8,008	7,007	6,006	5,005
- Intangibles	10[illegible],138	225,530	1[illegible]	1[illegible]	9[illegible],385	45,194	0	0	0	0	0	0	0	0	0	0	0
	153,76[illegible]	493,[illegible]3	44[illegible]	38[illegible]	[illegible]	26[illegible]	[illegible]	194,54[illegible]	179,5[illegible]	164,58[illegible]	149,[illegible]	134,6[illegible]	136,595	1[illegible]	10[illegible]	9[illegible]	76,[illegible]
2. Current Assets																	
- Accounts Receivable	0	0	12,[illegible]	1[illegible]	[illegible],754	[illegible]	[illegible]	[illegible]	[illegible]	26,[illegible]	28,621	2[illegible]	31,541	32,44[illegible]	[illegible]	3[illegible]	33,3[illegible]
- Inventory	0	0	6[illegible],648	[illegible]	[illegible]	1[illegible]	1[illegible]	145,381	149,634	150,956	151,894	15[illegible]	167,444	172,513	173,94[illegible]	175,437	177,055
- Cash in Hand	0	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,401
- Cash Balance	125,957	14,46[illegible]				0	0	0	0	0	0	0	0	16,688	42,77[illegible]	67,245	92,140
	125,957	14,467	78,345	119,88[illegible]	14[illegible]	153,[illegible]	15[illegible]	175,[illegible]	160,3[illegible]	181,756	18[illegible],901	184,[illegible]	201,26[illegible]	225,954	251,781	278,050	304,935
LIABILITIES	279,727	508,150	521,5[illegible]	502,96[illegible]	471,537	41[illegible],098	35[illegible]	3[illegible]	359,95[illegible]	34[illegible],344	332,510	318,837	337,855	347,572	356,421	369,72[illegible]	381,622
1. Equity Capital	2[illegible],81[illegible]	260,81[illegible]	260,81[illegible]	260,81[illegible]	260,81[illegible]	260,81[illegible]	260,81[illegible]	260,816	260,816	260,816	260,816	260,816	260,816	260,816	260,816	260,816	260,816
2. Revenue Reserves	0	0	(65,56[illegible])	([illegible],441)	(21[illegible])	(23[illegible])	(25[illegible])	(19[illegible],595)	(16[illegible])	(123,[illegible])	(82,430)	(40,125)	7,667	58,9[illegible]	[illegible]	[illegible]	92,277
3. Term Borrowings																	
- Foreign Currency Loan	16,92[illegible]	247,3[illegible]	315,229	25[illegible],18[illegible]	1[illegible]	1[illegible]	[illegible],045	0		0	0	0	0	0	0	0	0
- Local Currency Loan	0	0	0	56,475	37,[illegible]	18,825	0	0	0	0	0	0	0	0	0	0	0
	16,921	247,334	315,229	308,658	22[illegible],787	144,91[illegible]	[illegible],045	0	0	0	0	0	0	0	0	0	0
4. Current Liabilities																	
- Accounts Payable	0	0	9,641	15,433	19,5[illegible]	[illegible],246	2[illegible],774	23,40[illegible]	24,133	24,308	24,450	24,[illegible]	26,992	[illegible]	26,043	28,2[illegible]	28,529
- Cash Shortfall	0	0	21,787	78,515	174,44[illegible]	230,1[illegible]	265,08[illegible]	265,135	237,336	184,424	129,674	73,530	42,160	0	0	0	0
	0	0	31,428	93,948	193,9[illegible]	25[illegible]	285,656	3[illegible]	[illegible],469	2[illegible]	154,124	98,14[illegible]	69,152	27,81[illegible]	2[illegible]	28,276	28,529

APPENDIX 11-11

PROJECTED BALANCE SHEET : OPTION B

1. Assets

1.1 The figures quoted in respect of fixed assets reflect the value of the project investment by individual category, both initial and replacement, net of depreciation calculated at the rates specified in section 7.1 of Appendix 11-9.

1.2 The figures quoted in respect of accounts receivable, total inventory and cash in hand have been taken directly from the schedule detailing the working capital requirement in each year presented at Appendix 11-4.

1.3 For the purpose of the financial projections, it has been assumed that all cash surpluses reflected in the cash flow table at Appendix 11-10 would be retained as cash balances.

2. Liabilities

2.1 It has been assumed that there would be no change in the shareholding structure and, more specifically, no further increase in the issued and paid-up share capital to that detailed in the initial financing plan.

2.2 The figures quoted in respect of revenue reserves have been taken directly from the net income statement presented at Appendix 11-9, and reflect the accumulated profit position of the project.

2.3 Provision has been made for the foreign and local currency loans to be drawndown as per the initial financing plan detailed in Appendix 11-7, and to be repaid as specified in the cash flow table at Appendix 11-10.

2.4 The figures quoted in respect of accounts payable have been taken directly from the schedule detailing the working capital requirement in each year set out in Appendix 11-4.

2.5 The figures quoted in respect of the cash shortfall have been taken directly from the cash flow table presented at Appendix 11-10, and reflect the accumulated cash deficits of the project.

Appendix II-1[illegible]

[illegible] PENICILLIN PROJECT : OPTION [illegible]

CASH FLOW TABLE : TOTAL INVESTMENT

[illegible]

Year	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10	11	[illegible]	[illegible]	[illegible]	15
CASH INFLOWS																
Sales Revenue		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CASH OUTFLOWS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Investment Costs	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
Residual Value of Assets																[illegible]
Operating Costs		[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]								[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]			[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] PENICILLIN PROJECT [illegible]

CASH FLOW TABLE [illegible]

[illegible]

Year	0	1	2	3	4	5	6	7
INFLOWS								
1. Sales Revenues		[illegible]	[illegible]	[illegible]	340,3[illegible]	[illegible]	[illegible],630	[illegible]
CASH OUTFLOWS	([illegible])	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	([illegible])	([illegible])
1. Equity Subscription	([illegible])							
2. Replacement Investment							([illegible])	0
3. Residual Value of Assets					0		0	0
4. Debt Service (Repayment)								
- Forex Loan		0	([illegible])	([illegible])	([illegible])	([illegible])	([illegible])	0
- Local Loan	0	0	-	(16,525)	(18,[illegible])	(16,92[illegible])	0	0
5. Debt Service (Interest)								
- Forex Loan	-	(25,2[illegible])	([illegible])	([illegible])	([illegible])	(7,5[illegible])	(3,52[illegible])	0
- Local Loan		0	(14,119)	(11,7[illegible]5)	([illegible])	([illegible])	0	0
6. Operating Costs	-	(154,93[illegible])	([illegible],211)	([illegible])	([illegible])	([illegible])	331,52[illegible]	(341,0[illegible]4)
7. Corporate Tax							0	([illegible],058)
NET CASH FLOW	([illegible])	(25,79[illegible])	([illegible])	([illegible])	51,[illegible]	[illegible]	(4,18[illegible])	5[illegible],24[illegible]

Year	8	9	10	11	12	13	14	15
INFLOWS								
1. Sales Revenues	418,6[illegible]	[illegible]	42[illegible]	[illegible]	[illegible]	469,3[illegible]	49[illegible]	504,535
CASH OUTFLOWS	([illegible])	([illegible])	([illegible])	(421,284)	(41[illegible],775)	([illegible])	([illegible])	(354,630)
1. Equity Subscription		0	0	0	0	0	0	0
2. Replacement Investment	0	0	0	([illegible])	0		0	0
3. Residual Value of Assets	0	0	0		0	0	0	[illegible],68[illegible]
4. Debt Service (Repayment)								
- Forex Loan	0	0	0		0	0		
- Local Loan	0	0	0		0	0	0	0
5. Debt Service (Interest)								
- Forex Loan		0	0	0	0	0	0	0
- Local Loan	0	0	0	0	0	0	0	0
6. Operating Costs	(34[illegible])	(345,857)	(348,39[illegible])	(378,491)	(389,28[illegible])	([illegible])	(39[illegible],117)	(39[illegible])
7. Corporate Tax	([illegible])	(21,95[illegible])	(22,779)	(25,853)	([illegible],48[illegible])	(26,[illegible])	([illegible])	(31,75[illegible])
NET CASH FLOW	54,[illegible]	5[illegible],75[illegible]	5[illegible]	4[illegible]	[illegible]	[illegible],[illegible]45	7[illegible],31[illegible]	149,69[illegible]

Internal Rate of Return 1.7%

Net Present Value @ 1[illegible]% (77,505)

Net Present Value @ 15% (266,89[illegible])

APPENDIX 11-12

CASH FLOW TABLES : OPTION B

1. Total Investment

1.1 The figures quoted in respect of sales revenues, operating costs and corporate taxation have been taken directly from the net income statement presented at Appendix 11-9.

1.2 The figures quoted in respect of the total investment outlay have been taken directly from the schedule presented at Appendix 11-5, and reflect the sum of the initial investment costs, pre-production capital expenditures and the increase in working capital requirements in each year. For the purpose of these calculations, the investment outlay in the project implementation phase has been combined as one total.

1.3 The residual value of the assets reflects the total book value of the fixed assets of the project in 2009, as per the projected balance sheet presented at Appendix 11-11.

2. Equity Capital

2.1 The figures quoted in respect of sales revenues, operating costs and corporate taxation have been taken directly from the net income statement presented at Appendix 11-9.

2.2 The figures quoted in respect of equity subscription have been taken directly from the initial financing plan set out in Appendix 11-7.

2.3 The figures quoted in respect of replacement investment have been taken directly from the investment cost schedule set out in Appendix 11-5.

2.4 The residual value of the assets reflects the total book value of the fixed assets of the project in 2009, as per the projected balance sheet presented at Appendix 11-11.

2.5 The figures quoted in respect of debt service (repayments and interest) have all been taken directly from the cash flow table for financial planning which is presented at Appendix 11-10.

UNIDO PENICILLIN PROJECT : OPTION C

Appendix 12-1

INITIAL FIXED INVESTMENT COST

in Pesos '000

	Foreign Currency	Local Currency	Total Cost
1. Land			
Land Purchase	0	12,000	12,000
10% Contingency Allowance	0	1,200	1,200
	0	13,200	13,200
2. Site Preparation/Development			
Site Establishment & Development	0	6,500	6,500
10% Contingency Allowance	0	650	650
	0	7,150	7,150
3.1 Buildings & Civil Works			
Civils, Piling, Scaffolding, etc	0	43,789	43,789
Buildings - Fermentation etc	0	42,575	42,575
Buildings - 6-APA	0	13,000	13,000
Buildings - Semi-Synthetics	0	0	0
Mechanical, Piping, Steel Supply	103,116	10,312	113,428
E&I Installation	53,524	5,352	58,876
Insulation, Painting	0	10,431	10,431
Control System	0	47,060	47,060
Pre-Commissioning	3,653	0	3,653
10% Contingency Allowance	16,029	17,252	33,281
	176,322	189,771	366,093
3.2 Auxiliary & Service Facilities			
Transformer Sub-Station	0	814	814
Compressor House	0	3,250	3,250
Laboratory, Offices, Warehouse	0	16,250	16,250
Administration Block	0	6,825	6,825
10% Contingency Allowance	0	2,714	2,714
	0	29,853	29,853
4. Incorporated Fixed Assets			
Process Licences	14,396	0	14,396
Technology Transfer	36,400	0	36,400
10% Contingency Allowance	5,080	0	5,080
	55,876	0	55,876

	Foreign Currency	Local Currency	Total Cost
5.1 Production Machinery & Equipment			
Media Preparation	19,525	1,953	21,478
Additive Preparation	7,367	737	8,104
Penicillin Fermentation	67,502	6,750	74,252
Downstream Recovery	17,170	1,717	18,887
Penicillin Purification	24,617	2,462	27,079
6-APA Plant	7,781	778	8,559
Semi-Synthetics Production	0	0	0
Dosage Section	0	0	0
Packing, Insurance & Shipping	14,396	0	14,396
10% Contingency Allowance	15,836	1,440	17,276
	174,194	15,837	190,031
5.2 Ancillary Production Equipment			
Piping	38,020	3,802	41,822
Electrical	25,347	2,535	27,882
Instrumentation	63,367	6,337	69,704
Commissioning Spares	5,702	570	6,272
Packing, Insurance & Shipping	6,622	0	6,622
10% Contingency Allowance	13,906	1,324	15,230
	152,964	14,568	167,532
5.3 Auxiliary Equipment			
Utilities	107,687	10,769	118,456
Mechanical Handling	1,820	182	2,002
Workshop Equipment	3,900	390	4,290
Laboratory Equipment	1,300	130	1,430
Packing, Insurance & Shipping	11,471	0	11,471
10% Contingency Allowance	12,618	1,147	13,765
	138,796	12,618	151,414
5.4 Vehicles			
Company Cars - Senior Management	0	1,600	1,600
Company Cars - Sales & Distribution	0	400	400
Lorry, Pick-up Truck, Fork-Lift	0	1,900	1,900
10% Contingency Allowance	0	390	390
	0	4,290	4,290
5.5 Service Equipment			
Office Equipment & Furniture	0	7,150	7,150
Canteen & Medical Facilities	0	3,900	3,900
10% Contingency Allowance	0	1,105	1,105
	0	12,155	12,155
Total	698,152	299,442	997,594

APPENDIX 12-1

INITIAL FIXED INVESTMENT COSTS : OPTION C

1. **Land**

1.1 It has been assumed that the project would be located in the Light Industry and Science Park in the Calabar region. The cost of a suitable site measuring 10,000 sq.m. in total has been based on an average price of P 1,200 per sq.m., as per information obtained in the Philippines.

1.2 Provision has been made for a contingency allowance of 10%, calculated by reference to the purchase price of the land.

2. **Site Preparation and Development**

2.1 The price quoted of P 6.5 million should cover all initial site preparation and subsequent development work, including landscaping, internal roadways and parking areas, security fencing and gatehouse, connections to mains electricity and water, etc.

2.2 Provision has been made for a contingency allowance of 10%, calculated by reference to the total cost estimate.

3. **Buildings and Civil Works**

3.1 The prices quoted are in accordance with the detailed cost estimates presented at Appendix 9-2, converted into Pesos.

3.2 Further provision has been made for payment of 10% customs duties on all imported items (mechanical erection, piping, steel supply, fire/gas supply, electrics and instrumentation installation), and for an overall 10% contingency allowance.

4. **Incorporated Fixed Assets**

4.1 The cost of process licensing has been estimated at 10% of the process equipment, as per the detailed cost estimates presented at Appendix 9-2. The additional cost of initial technology transfer in respect of penicillin production has also been included, broken down as follows :

Hindustan Antibiotics Ltd	:	US$ 0.9 million
Panlabs Incorporated	:	US$ 0.5 million

4.2 Provision has been made for a contingency allowance of 10%, calculated by reference to the total cost estimate.

5. **Production/Auxiliary Machinery and Equipment**

5.1 The prices quoted are in accordance with the detailed cost estimates presented at Appendix 9-2, converted into Pesos.

5.2 Further provision has been made for payment of 10% customs duties on all imported items, and for an overall contingency allowance of 10%.

6. **Vehicles**

6.1 It has been assumed that the project would require the following vehicles, all of which could be purchased from local suppliers :

4 x Company Cars - Senior Management
1 x Company Car - Sales and Distribution Staff
1 x 3-tonne Lorry
1 x Pick-up Truck or Van
1 x Fork-lift Truck

6.2 The prices quoted have been based on information obtained in the Philippines. Separate provision has been made for a contingency allowance of 10%, calculated by reference to the total cost estimate.

7. **Service Equipment**

7.1 It has been assumed that all office equipment and furniture would be purchased from local suppliers, as would canteen and medical facilities for the project staff. The cost of these items has been estimated by reference to the nature of the project and the number of employees.

7.2 Separate provision has been made for a contingency allowance of 10%, calculated by reference to the total cost estimate.

UNIDO PENICILLIN PROJECT : OPTION C

Appendix 12-2

INITIAL FIXED INVESTMENT COST SCHEDULE

in Pesos '000

Year	1993	1994	1995
1. Land			
- Foreign Currency	0	0	0
- Local Currency	13,200	0	0
- Total	13,200	0	0
2. Site Preparation/Development			
- Foreign Currency	0	0	0
- Local Currency	7,150	0	0
- Total	7,150	0	0
3. Structures & Civil Works			
- Foreign Currency	35,264	141,058	0
- Local Currency	43,925	175,699	0
- Total	79,189	316,757	0
4. Incorporated Fixed Assets			
- Foreign Currency	0	27,938	27,938
- Local Currency	0	0	0
- Total	0	27,938	27,938
5. Plant, Machinery & Equipment			
- Foreign Currency	49,427	384,520	32,007
- Local Currency	4,526	51,998	2,944
- Total	53,953	436,518	34,951
6. Total Initial Investment Costs			
- Foreign Currency	84,691	553,516	59,945
- Local Currency	68,801	227,697	2,944
Total	153,492	781,213	62,889

APPENDIX 12-2

INITIAL FIXED INVESTMENT COST SCHEDULE : OPTION C

1. **Land and Site Development**

1.1 It has been assumed that the entire cost of purchasing and developing the project site would be incurred in 1993, this being the first year of project implementation.

2. **Structures and Civil Works**

2.1 It has been assumed that 20% of the cost of the structures and civil works would be incurred in 1993, and the balance of 80% upon completion of this work in 1994.

3. **Incorporated Fixed Assets**

3.1 It has been assumed that 50% of the combined cost of the process licences and technology transfer would be incurred in 1994, and the balance of 50% upon the commencement of operations in 1995.

4. **Production Machinery and Equipment**

4.1 It has been assumed that the suppliers of the production machinery and equipment would require a 20% downpayment in 1993, and that a further 70% of the total purchase price would be payable in 1994. Provision has therefore been made for retention of the balance of 10% until the commencement of operations in 1995, by way of performance guarantee.

5. **Ancillary and Auxiliary Equipment**

5.1 It has been assumed that the suppliers of the ancillary production equipment and of the auxiliary equipment would also require a 5% downpayment in 1993, and that a further 90% of the total purchase price would be payable in 1994. Provision has again been made for retention of the balance of 5% until 1995, by way of performance guarantee.

6. **Vehicles and Service Equipment**

6.1 It has been assumed that the entire cost of purchasing the vehicles, office equipment/furniture and canteen/medical facilities required would be incurred in the final phase of project implementation in 1994, immediately prior to the start-up of operations.

UNIDO PENICILLIN PROJECT : OPTION C

Appendix 12-3

PRE-PRODUCTION EXPENDITURE SCHEDULE

in Pesos '000

Year	1993	1994	1995
1. Pre-Investment Studies			
- Foreign Currency	8,580	0	0
2. Preparatory Engineering Studies			
- Foreign Currency	20,449	0	0
3. Management of Project Implementation			
- Foreign Currency	2,808	11,232	0
4. Detailed Engineering/Tendering			
- Foreign Currency	113,256	75,504	0
5. Supervision, Testing and Commissioning			
- Foreign Currency	13,618	54,471	0
- Local Currency	1,730	6,918	0
- Total	15,348	61,389	0
6. Recruitment and Staff Training			
- Foreign Currency	0	7,800	0
- Local Currency	0	1,300	0
- Total	0	9,100	0
7. Arrangements for Supplies			
- Local Currency	0	520	0
8. Arrangements for Marketing			
- Local Currency	0	2,080	0
9. Build-up of Connections			
- Local Currency	520	780	0
10. Capital Issue Expenditure			
- Local Currency	1,300	5,200	0
11. 10% Contingency Allowance			
- Foreign Currency	15,871	14,901	0
- Local Currency	355	1,680	0
- Total	16,226	16,581	0
12. Total Pre-Production Expenditure			
- Foreign Currency	174,582	163,908	0
- Local Currency	3,905	18,478	0
Total	178,487	182,386	0

APPENDIX 12-3

PRE-PRODUCTION EXPENDITURE SCHEDULE : OPTION C

1. **Pre-Investment and Preparatory Engineering Studies**

1.1 It has been assumed that the entire cost of pre-investment and preliminary engineering studies would be incurred in the earliest phase of project implementation in 1993.

2. **Management of Project Implementation**

2.1 It has been assumed that 20% of the cost of the management team in charge of project implementation would be incurred during 1993, and the balance of 80% during 1994.

3. **Detailed Engineering and Tendering**

3.1 It has been assumed that 60% of the cost of the detailed engineering work to be undertaken would be incurred during 1993, and the balance of 40% during 1984.

4. **Supervision, Testing and Commissioning**

4.1 It has been assumed that 20% of the total combined cost of supervising the buildings and civil works, and testing and commissioning the plant and equipment, would be incurred during 1993, and the balance of 80% during 1994.

5. **Recruitment and Staff Training**

5.1 It has been assumed that the entire cost of recruiting staff and sending them for advance training overseas would be incurred in 1994, immediately prior to the commencement of operations.

6. **Arrangements for Supplies and Marketing**

6.1 It has been assumed that all preliminary expenditure in respect of arrangements for supplies and marketing would be incurred in 1994, prior to the start-up of operations.

7. **Build-up of Connections and Capital Issue Expenditure**

7.1 It has been assumed that 40% of the cost of project and other approvals and 20% of the cost of legal and other fees related to the registration and financing of the project would be incurred in 1993, with the respective balances of 60% and 80% falling due in 1994.

UNIDO PENICILLIN PROJECT : OPTION C

Appendix 12-4

WORKING CAPITAL REQUIREMENTS

in Pesos '000

		Minimum Coverage	Turnover Coefficient	1995	1996	1997	1998	1999
1.	Current Assets							
	a) Accounts Receivable	30	12	15,225	22,015	26,527	26,480	26,417
	b) Inventory							
	- Local Materials	10	36	1,205	1,914	2,386	2,386	2,386
	- Imported Materials	120	3	18,397	29,120	36,145	35,759	35,297
	- Spare Parts	180	2	5,090	5,345	5,612	5,892	6,187
	- Work-in-Progress	30	12	13,596	20,387	24,898	24,851	24,788
	- Finished Products	30	12	15,116	21,906	26,417	26,371	26,307
	c) Cash in Hand	15	24	4,793	5,021	4,489	3,832	3,176
	Total Current Assets			73,422	105,708	126,474	125,571	124,558
2.	Current Liabilities							
	a) Accounts Payable	30	12	11,184	17,737	22,074	21,976	21,857
3.	Working Capital							
	a) Net Working Capital			62,238	87,971	104,400	103,595	102,701
	b) Increase in Working Capital			62,238	25,733	16,429	(805)	(894)
4.	Total Production Costs			379,916	464,025	503,308	486,344	469,183
	less : Raw Materials			98,573	156,262	194,347	193,191	191,804
	: Utilities			35,631	56,585	70,543	70,516	70,483
	: Depreciation			130,672	130,672	130,672	130,672	130,671
				115,040	120,506	107,746	91,965	76,225
5.	Required Cash Balance	15	24	4,793	5,021	4,489	3,832	3,176

Accounts Receivable : 30 days x operating costs (production costs minus depreciation and interests)
Work-in-Progress : 30 days x factory costs
Finished Products : 30 days x factory costs plus administrative overheads
Cash in Hand : 15 days x production costs (less raw materials, utilities and depreciation)
Accounts Payable : 30 days x raw materials and utilities

UNIDO PENICILLIN PROJECT : OPTION C

Appendix 12-4

CALCULATION OF WORKING CAPITAL

in Pesos '000

Year		1995	1996	1997	1998	1999
	Raw Materials					
	- Local Materials	43,382	68,901	85,913	85,913	85,913
	- Imported Materials	55,191	87,361	108,434	107,278	105,891
	Direct Labour	5,840	5,840	5,840	5,840	5,840
	Utilities	35,631	5[illegible].585	70,543	70,516	70,483
	Replacement Spare Parts	10,180	[illegible],689	11,223	1[illegible] 784	12,373
	Repairs & Maintenance	3,832	6,163	7,724	7,784	7,857
	Factory Overhead Costs	9,100	9,100	9,100	9,100	9,100
1.	Total Factory Costs	163,156	244,639	298,777	298,215	297,457
	Administrative Overheads	18,231	18,231	18,231	18,231	18,231
	Sales & Distribution Costs	1,315	1,315	1,315	1,315	1,315
2.	Operating Costs	182,702	264,185	318,323	317,761	317,003
	Financial Costs	66,542	69,168	54,313	37,911	21,509
	Depreciation	130,672	130,672	130,672	130,672	130,671
3.	Total Production Costs	379,916	464,025	503,308	486,344	469,183

APPENDIX 12-4

CALCULATION OF WORKING CAPITAL : OPTION C

1. Calculation of Working Capital Requirement

1.1 The provisions made in respect of total current assets and current liabilities have been calculated by reference to the following minimum requirements :

Accounts Receivable	:	30 days x operating costs
Inventory		
- Local Materials	:	10 days x cost of materials
- Imported Materials	:	120 days x cost of materials
- Spare Parts	:	180 days x cost of spare parts
- Work-in-Progress	:	30 days x factory costs
- Finished Products	:	30 days x factory costs plus administrative overheads
Cash in Hand	:	15 days x production costs less raw materials, utilities and depreciation
Accounts Payable	:	30 days x cost of raw materials plus utilities

1.2 The difference between total current assets and current liabilities represents the net working capital requirement in each year.

1.3 The total initial investment costs of the project include provision for the net working capital requirement in 1997, given that the plant would then be operating at its maximum of 91% capacity utilisation.

2. Total Production Costs

2.1 The figures quoted in respect of total factory costs, administrative overheads, sales and distribution costs, financial costs and depreciation have been taken directly from the detailed production cost schedule presented at Appendix 12-8b.

UNIDO PENICILLIN PROJECT : OPTION C

Appendix 12-5

TOTAL INVESTMENT COST SCHEDULE : 1993 - 1999

in Pesos '000

Year	1993	1994	1995	1996	1997	1998	1999
1. Initial Investment Costs							
- Foreign Currency	84,691	553,516	59,945	0	0	0	0
- Local Currency	68,801	227,697	2,944	0	0	0	0
- Total	153,492	781,213	62,889	0	0	0	0
Replacement Investment							
- Foreign Currency	0	0	0	0	0	0	0
- Local Currency	0	0	0	0	0	0	0
- Total	0	0	0	0	0	0	0
2. Preproduction Expenditure							
- Foreign Currency	174,582	163,908	0	0	0	0	0
- Local Currency	3,905	18,478	0	0	0	0	0
- Total	178,487	182,386	0	0	0	0	0
3. Working Capital Increase	0	0	62,238	25,733	16,429	(805)	(894)
Total Investment Costs	331,979	963,599	125,127	25,733	16,429	(805)	(894)

APPENDIX 12-5

TOTAL INVESTMENT COST SCHEDULE : OPTION C

1. Initial and Replacement Investment Costs

1.1 The figures quoted in respect of initial investment costs have been taken directly from the cost schedule presented at Appendix 12-2.

1.2 It has been assumed that there would be no replacement investment during the period to 1999.

2. Pre-Production Expenditure

2.1 The figures quoted in respect of pre-production capital expenditure have been taken directly from the expenditure schedule presented at Appendix 12-3.

3. Working Capital Increase

3.1 The figures quoted in respect of the increase in the net working capital requirement in each year have been taken directly from the working capital schedule presented at Appendix 12-4.

UNIDO PENICILLIN PROJECT : OPTION C

TOTAL ASSETS SCHEDULE : 1993 - 1999

Appendix 12-6

in Pesos '000

Year		1993	1994	1995	1996	1997	1998	1999
1.	Initial Investment Costs							
	- Foreign Currency	84,691	553,516	59,945	0	0	0	0
	- Local Currency	68,801	227,697	2,944	0	0	0	0
	- Total	153,492	781,213	62,889	0	0	0	0
	Replacement Investment							
	- Foreign Currency	0	0	0	0	0	0	0
	- Local Currency	0	0	0	0	0	0	0
	- Total	0	0	0	0	0	0	0
2.	Preproduction Expenditure							
	- Foreign Currency	174,582	163,908	0	0	0	0	0
	- Local Currency	3,905	18,478	0	0	0	0	0
	- Total	178,487	182,386	0	0	0	0	0
3.	Current Assets Increase	0	0	73,422	32,286	20,766	(903)	(1,013)
	Total Assets	331,979	963,599	136,311	32,286	20,766	(903)	(1,013)

APPENDIX 12-6

TOTAL ASSETS SCHEDULE : OPTION C

1. Initial and Replacement Investment Costs

1.1 The figures quoted in respect of initial investment costs have been taken directly from the cost schedule presented at Appendix 12-2.

1.2 It has been assumed that there would be no replacement investment during the period to 1999.

2. Pre-Production Expenditure

2.1 The figures quoted in respect of pre-production capital expenditure have been taken directly from the expenditure schedule presented at Appendix 12-3.

3. Current Assets Increase

3.1 The figures quoted in respect of the increase in current assets in each year have been calculated by reference to the working capital schedule detailed in Appendix 12-4.

3.2 The total initial assets of the project include provision for the total current assets figure in 1997, given that the plant would then be operating at its maximum of 91% capacity utilisation.

UNIDO PENICILLIN PROJECT : OPTION C

Appendix 12-7

INITIAL FINANCING PLAN

in Pesos '000

Year		1993	1994	1995	1996	1997	1998	1999
1.	Equity Subscription							
	- Promoters	356,386	0	0	0	0	0	0
	- Financial Institutions	237,590	0	0	0	0	0	0
2.	Foreign Currency Loans	21,683	717,424	92,666	0	0	0	0
3.	Local Currency Loans	0	0	0	37,118	0	0	0
4.	Current Liabilities	0	0	11,184	6,553	4,337	(98)	(119)
	Total	615,659	717,424	103,850	43,671	4,337	(98)	(119)

APPENDIX 12-7

INITIAL FINANCING PLAN : OPTION C

1. Equity Subscription

1.1 It has been assumed that both the local promoters and those financial institutions invited to participate in the project would subscribe for their shares in full during 1993, and would therefore take up their respective shareholdings of 60% and 40% at the outset.

1.2 It may be noted that this would ensure that the project had sufficient funds in hand to cover anticipated expenditure on local investment items, including working capital, during the implementation phase and the first year of operations.

2. Foreign Currency Loans

2.1 It has been assumed that the foreign currency loans would be drawndown in three tranches as follows :

1993	:	P 21,683,000	=	2.6%
1994	:	P 717,424,000	=	86.3%
1995	:	P 92,666,000	=	11.1%
		P 831,773,000		

2.2 It may be noted that this would ensure that the project had sufficient funds in hand to cover anticipated expenditure on imported investment items, including working capital, during both the implementation phase and the 3-year build-up to full capacity utilisation in 1997.

3. Local Currency Loans

3.1 It has been assumed that the local currency loans would be drawndown in their entirety in 1996, and would therefore be used to fund the balance of the working capital requirement of the project.

4. Current Liabilities

4.1 The figures quoted in respect of the increase in current liabilities in each year have been calculated by reference to the working capital schedule detailed in Appendix 12-4.

UNIDO PENICILLIN PROJECT : OPTION C

Appendix 12-8a

PRODUCTION COST SCHEDULE

in Pesos '000

Year	1995	1996	1997	1998	1999
1. Direct Materials & Inputs	134,204	212,847	264,890	263,707	262,287
2. Direct Manpower	5,840	5,840	5,840	5,840	5,840
3. Factory Overheads	23,112	25,952	28,047	28,668	29,330
Factory Costs	163,156	244,639	298,777	298,215	297,457
4. Administrative Overheads	18,231	18,231	18,231	18,231	18,231
5. Sales & Distribution Costs	1,315	1,315	1,315	1,315	1,315
Operating Costs	182,702	264,185	318,323	317,761	317,003
6. Financial Costs	66,542	69,168	54,313	37,911	21,509
7. Depreciation	130,672	130,672	130,672	130,672	130,671
Total Production Cost	379,916	464,025	503,308	486,344	469,183

UNIDO PENICILLIN PROJECT : OPTION C — Appendix 12-8b

DETAILED PRODUCTION COST SCHEDULE — in Pesos '000

Year		1995	1996	1997	1998	1999
1.1 Direct Materials						
Fermentation Materials	- Imported	24,497	38,901	48,510	48,510	48,510
	- Local	43,382	68,901	85,913	85,913	85,913
Extraction Materials	- Imported	15,661	24,871	31,015	31,015	31,015
6-APA Production	- Imported	15,033	23,589	28,909	27,753	26,366
Bulk Ampicillin	- Imported	0	0	0	0	0
Bulk Amoxycillin	- Imported	0	0	0	0	0
Bulk Cloxacillin	- Imported	0	0	0	0	0
Final Dosage Forms	- Imported	0	0	0	0	0
		98,573	156,262	194,347	193,191	191,804
1.2 Utilities						
Fermentation/Extraction		35,277	56,029	69,862	69,862	69,862
6-APA Production		354	556	681	654	621
Bulk Ampicillin		0	0	0	0	0
Bulk Amoxycillin		0	0	0	0	0
Bulk Cloxacillin		0	0	0	0	0
Final Dosage Forms		0	0	0	0	0
		35,631	56,585	70,543	70,516	70,483
2. Direct Manpower		5,840	5,840	5,840	5,840	5,840
3. Factory Overheads						
Manpower		7,800	7,800	7,800	7,800	7,800
Replacement Spare Parts		10,180	10,689	11,223	11,784	12,373
Repairs & Maintenance		3,832	6,163	7,724	7,784	7,857
Protective Clothing, etc		1,300	1,300	1,300	1,300	1,300
		23,112	25,952	28,047	28,668	29,330
4. Administrative Overheads						
Manpower		4,550	4,550	4,550	4,550	4,550
Insurance		9,214	9,214	9,214	9,214	9,214
Office Supplies		650	650	650	650	650
Communications		650	650	650	650	650
Land/Property Charges		156	156	156	156	156
Technology Transfer		1,950	1,950	1,950	1,950	1,950
Licences & Fees		130	130	130	130	130
Travel & Transport		400	400	400	400	400
Sundries		531	531	531	531	531
		18,231	18,231	18,231	18,231	18,231

DETAILED PRODUCTION COST SCHEDULE Continued

Year	1995	1996	1997	1998	1999
5. Sales & Distribution Costs					
Manpower	680	680	680	680	680
Product Promotion	555	555	555	555	555
Travel	80	80	80	80	80
Office Rental	0	0	0	0	0
Sales Commissions	0	0	0	0	0
	1,315	1,315	1,315	1,315	1,315
6. Financial Costs					
Foreign Currency Loans	66,542	59,888	46,580	33,271	19,962
Local Currency Loans	0	9,280	7,733	4,640	1,547
	66,542	69,168	54,313	37,911	21,509
7. Depreciation					
Buildings	19,798	19,798	19,798	19,798	19,798
Plant, Machinery & Equipment	25,450	25,450	25,450	25,450	25,450
Vehicles	858	858	858	858	858
Service Equipment	1,216	1,216	1,216	1,216	1,216
Intangibles	83,350	83,350	83,350	83,350	83,349
	130,672	130,672	130,672	130,672	130,671
Total Production Cost	379,916	464,025	503,308	486,344	469,183

APPENDIX 12-8

PRODUCTION COST SCHEDULE : OPTION C

1. Direct Materials and Inputs

1.1 Expenditure on raw material inputs has been calculated by reference to the detailed production schedule presented at Appendix 3-30, and the following usage and cost figures :

Penicillin

	kg/batch*	cost/tonne
Imported Fermentation Materials		
- Calcium Carbonate	15,157	$ 270
- Sodium Sulphate	9,549	$ 146
- Potassium Hydrogen Phosphate	909	$ 1,992
- Ammonium Sulphate	7,650	$ 26
- Ammonia Gas	940	$ 184
- Sulphuric Acid	1,440	$ 35
- Phenyl Acetic Acid Salt	9,900	$ 1,086
Local Fermentation Materials		
- Corn Steep Liquor	60,633	P 8,900
- Soy Bean Oil (medium)	4,729	P 21,000
- Soy Bean Oil (feedings)	1,260	P 21,000
- Sucrose Solution	50,400	P 3,675
Imported Extraction Materials		
- Butyl Acetate	5,530	$ 1,500
- Active Carbon	17	$ 996
- Sodium Bicarbonate	809	$ 881
- Butanol	2,390	$ 1,166

* production per batch = 2,584 kg of penicillin (net of 10% losses in production)

6-APA

	kg/tonne	cost/tonne
Imported Production Materials		
- Dichloromethane	6,000	$ 905
- Ammonia	1,500	$ 190
- Hydrochloric Acid 30%	2,000	$ 90
- Acetone	2,500	$ 1,200

1.2 It may be noted that all raw material costs are quoted per tonne of active ingredient, delivered to the factory site. In the case of imported materials, provision has also been made in the cost for payment of 10% customs duties.

1.3 Expenditure on utilities has been calculated by reference to the detailed production schedule presented at Appendix 3-30, and the following usage and cost figures :

Penicillin	units/batch*	cost/unit
- Steam (tonnes)	120	P 600
- Power (Mwh)	279	P 2,220
- Water (cu.metres)	135	P 3

* production per batch = 2,584 kg of penicillin (net of 10% losses in production)

6-APA	cost/tonne of product
Steam/Power/Water	P 5,450

2. **Direct Manpower**

2.1 The wage and salary cost of the production staff employed in the factory has been estimated at a total of just under P 5.85 million per annum. This figure may be broken down as follows :

	Number	Salary	Annual Cost
Direct Production Staff			
- Production Supervisors	10	180,000	1,800,000
- Technicians	19	120,000	2,280,000
- Skilled Workers	12	80,000	960,000
- Unskilled Labour	20	40,000	800,000
Total	61		5,840,000

3. **Factory Overheads**

3.1 The wage and salary cost of the laboratory and engineering staff employed in the factory has been estimated at a total of P 7.8 million per annum. This figure may be broken down as follows :

	Number	Salary	Annual Cost
Laboratory/Engineering Staff			
- Supervisors	16	180,000	2,880,000
- Technicians	17	120,000	2,040,000
- Skilled Workers	26	80,000	2,080,000
- Unskilled Labour	20	40,000	800,000
Total	79		7,800,000

3.2 The provision made for the importation of replacement spare parts has been calculated at 2% of the initial value of the production and auxiliary machinery and equipment to be installed in the factory. However, this figure has then been projected to rise at a compound growth rate of 5% per annum to cover the expected increase in servicing needs over time.

3.3 The provision made for repairs and maintenance has been calculated at the rate of 3% by reference to projected sales revenues in each year.

3.4 Additional provision has been made for annual expenditures totalling P 1.3 million on protective clothing and sundry other consumables such as cleaning materials, lubricants and loose tools used within the factory complex.

4. Administrative Overheads

4.1 The wage and salary cost of the senior management team and the administration and other personnel employed has been estimated at a total of P 4.55 million per annum. This figure may be broken down as follows :

	Number	Salary	Annual Cost
Senior Management			
- Chief Executive	1	800,000	800,000
- Directors	2	500,000	1,000,000
- Production/Lab/Engineering	3	250,000	750,000
- Commercial/Administration	2	250,000	500,000
Administration/Other Personnel			
- Accounts Officer	1	120,000	120,000
- Storekeepers	4	60,000	240,000
- Secretaries	4	60,000	240,000
- Security Officers	2	60,000	120,000
- Clerical Staff	8	40,000	320,000
- Drivers	5	40,000	200,000
- Receptionists	2	30,000	60,000
- Watchmen	8	25,000	200,000
Total	42		4,550,000

4.2 The cost of insuring the factory and other buildings, plus all the plant, machinery and equipment installed therein and the project vehicles, against fire, theft and accidental damage has been estimated at 1% of the initial value of the assets. The figure quoted of approximately P 9.2 million should also include the cost of providing accident cover for the workforce.

4.3 Various provisions totalling just under P 2 million have been specified to cover annual expenditures on office supplies, communications, land/property charges, licences, fees and travel/transport.

4.4 It has been assumed that the project would be required to make an annual payment of $ 75,000 in respect of technology transfer for the strain development programme for penicillin production in each of the first five years of operation.

4.5 Finally, provision has been made for what is, in effect, a contingency allowance, calculated at 3% of total overhead costs, to cover those items which have not been separately specified (such as donations, entertainment, staff medical and canteen expenses and the like).

5. Sales and Distribution Costs

5.1 The wage and salary cost of the sales and distribution team employed within the factory complex has been estimated at a total of just under P 0.7 million per annum. This figure may be broken down as follows :

	Number	Salary	Annual Cost
Management			
- Sales Director	1	500,000	500,000
Other Personnel			
- Salesman (Pen-G & 6-APA)	1	180,000	180,000
Total	2		680,000

5.2 The figures quoted in respect of product promotion and travel/transport have been taken directly from the detailed cost schedule presented at Appendix 3-28 (Option C refers).

6. Financial Costs

6.1 It has been assumed that the foreign currency loans would be made available on the basis of the following terms and conditions :

Loan Amount	:	P 831,773,000, equivalent to just under $ 32 million.
Loan Term	:	6 years, inclusive of a grace period of one year.
an Drawdown	:	final tranche drawn by mid-1995.
Interest Rate	:	8% per annum, payable on the balance outstanding.
Repayment	:	in five equal annual instalments, commencing one year after final drawdown (that is, by mid-1996).

6.2 It has been assumed that the local currency loans would be made available on the basis of the following terms and conditions :

Loan Amount	:	P 37,118,000, equivalent to just over $ 1.4 million.
Loan Term	:	4 years, inclusive of a grace period of one year.
Loan Drawdown	:	by mid-1996.
Interest Rate	:	25% per annum, payable on the balance outstanding.
Repayment	:	in three equal annual instalments, commencing one year after drawdown (that is, by mid-1997).

7. Depreciation

7.1 Depreciation in respect of the proposed investment has been calculated on a straight line basis in accordance with the following rates :

Buildings and Civil Works	:	5%
Auxiliary and Service Facilities	:	5%
Production Equipment	:	5%
Ancillary Production Equipment	:	5%
Auxiliary Equipment	:	5%
Vehicles	:	20%
Service Equipment	:	10%
Intangibles *	:	20%

* incorporated fixed assets and pre-production capital expenditure

UNIDO PENICILLIN PROJECT : OPTION C

NET INCOME STATEMENT

Appendix 12-9

in Pesos '000

Year	1995	1996	1997	1998	1999
1. Sales Revenues	127,728	205,447	257,468	259,480	261,895
2. Operating Costs	182,702	264,185	318,323	317,761	317,003
3. Operating Profit/(Loss)	(54,974)	(58,738)	(60,855)	(58,281)	(55,108)
4. Financial Costs	66,542	69,168	54,313	37,911	21,509
5. Depreciation	130,672	130,672	130,672	130,672	130,671
6. Gross Profit/(Loss) before Tax	(252,188)	(258,578)	(245,840)	(226,864)	(207,288)
7. Corporate Taxation	0	0	0	0	0
8. Net Profit/(Loss)	(252,188)	(258,578)	(245,840)	(226,864)	(207,288)
9. Dividends	0	0	0	0	0
10. Retained Profits	(252,188)	[illegible]8,578)	(245,840)	(226,864)	(207,288)
11. Revenue Reserves	(252,188)	(510,766)	(756,606)	(983,470)	(1,190,758)
Gross Profit : Sales	-197.4%	-125.9%	-95.5%	-87.4%	-79.1%
Net Profit : Equity	-42.5%	-43.5%	-41.4%	-38.2%	-34.9%

APPENDIX 12-9

NET INCOME STATEMENT : OPTION C

1. Sales Revenues

1.1 The figures quoted in respect of sales revenues have been taken directly from the detailed schedules presented at Appendices 3-26 and 3-27 (Option C refers).

2. Operating Costs, Financial Costs and Depreciation

2.1 The figures quoted in respect of operating costs, financial costs and depreciation have all been taken directly from the production cost schedule presented at Appendix 12-8a.

3. Taxation

3.1 It has been assumed that the project would be successful in negotiating an initial tax holiday of six years from the commencement of commercial operations.

3.2 However, the extent of the losses anticipated over this period is such that, in effect, this tax exemption becomes immaterial.

4. Dividends

4.1 Given the magnitude of the losses anticipated, the project would not be in a position to declare dividends throughout the period under review.

5. Revenue Reserves

5.1 The revenue reserves reflect the accumulated loss position of the project, and the changes thereto, as reflected in the income statement and final loss figure for each year.

UNIDO PENICILLIN PROJECT : OPTION C

Appendix 12-10

CASH FLOW TABLE FOR FINANCIAL PLANNING

in Pesos '000

Year	1993	1994	1995	1996	1997	1998	1999
CASH INFLOW	615,659	717,424	231,578	249,118	261,805	259,382	261,776
1. Financial Resources	615,659	717,424	103,850	43,671	4,337	(98)	(119)
2. Sales Revenues	0	0	127,728	205,447	257,468	259,480	261,895
CASH OUTFLOW	(331,979)	(963,599)	(385,555)	(531,994)	(572,130)	(533,497)	(516,226)
1. Total Assets Schedule	(331,979)	(963,599)	(136,311)	(32,286)	(20,766)	903	1,013
2. Operating Costs	0	0	(182,702)	(264,185)	(318,323)	(317,761)	(317,003)
3. Debt Service : Interest							
- Foreign Currency Loans	0	0	(66,542)	(59,888)	(46,580)	(33,271)	(19,962)
- Local Currency Loans	0	0	0	(9,280)	(7,733)	(4,640)	(1,547)
Debt Service : Repayments							
- Forex Loan	0	0	0	(166,355)	(166,355)	(166,355)	(166,355)
- Local Loan	0	0	0	0	(12,373)	(12,373)	(12,372)
4. Corporate Tax	0	0	0	0	0	0	0
5. Dividends	0	0	0	0	0	0	0
SURPLUS/(DEFICIT)	283,680	(246,175)	(153,977)	(282,876)	(310,325)	(274,115)	(254,450)
CUMULATIVE CASH SHORTFALL	283,680	37,505	(116,472)	(399,348)	(709,673)	(983,788)	1,238,238)

APPENDIX 12-10

CASH FLOW TABLE FOR FINANCIAL PLANNING : OPTION C

1. **Cash Inflow**

1.1 The figures quoted in respect of financial resources have been taken directly from the initial financing plan detailed in Appendix 12-7, and reflect the sum of the subscription for equity in the project, the foreign and local currency loans drawndown and the increase in current liabilities in each year.

1.2 The figures quoted in respect of sales revenues have been taken directly from the net income statement presented at Appendix 12-9.

2. **Cash Outflow**

2.1 The figures quoted in respect of total assets have been taken directly from the total assets schedule detailed in Appendix 12-6 and reflect the sum of the initial investment costs, pre-production capital expenditures and the increase in current assets in each year.

2.2 The figures quoted in respect of operating costs have been taken directly from the net income statement presented at Appendix 12-9.

2.3 The figures quoted in respect of debt service have been calculated on the basis of the terms and conditions assumed for the foreign and local currency loans, as respectively detailed in sections 6.1 and 6.2 of Appendix 12-9 :

Foreign Currency Loans
Interest Rate : 8% per annum, payable on the balance outstanding.
Repayment : in five equal annual instalments, commencing one year after final drawdown (that is, by mid-1996).

Local Currency Loans
Interest Rate : 25% per annum, payable on the balance outstanding.
Repayment : in three equal annual instalments, commencing one year after drawdown (that is, by mid-1997).

2.4 Neither taxation nor dividends would be payable throughout the period under review.

UNIDO PENICILLIN PROJECT : OPTION C — Appendix 12-11

PROJECTED BALANCE SHEET

in Pesos '000

Year		1993	1994	1995	1996	1997	1998	1999
ASSETS		615,659	1,333,083	1,301,217	1,202,831	1,092,925	961,350	829,666
1.	Fixed Assets							
	- Land	20,350	20,350	20,350	20,350	20,350	20,350	20,350
	- Buildings	79,189	395,946	376,148	356,350	336,552	316,754	296,956
	- Plant & Machinery	53,953	474,026	483,527	458,077	432,627	407,177	381,727
	- Vehicles	0	4,290	3,432	2,574	1,716	858	0
	- Service Equipment	0	12,155	10,939	9,723	8,507	7,291	6,075
	- Intangibles	178,487	388,811	333,399	250,049	166,699	83,349	0
		331,979	1,295,578	1,227,795	1,097,123	966,451	835,779	705,108
2.	Current Assets							
	- Accounts Receivable	0	0	15,225	22,015	26,527	26,480	26,417
	- Inventory	0	0	53,404	78,672	95,458	95,259	94,965
	- Cash in Hand	0	0	4,793	5,021	4,489	3,832	3,176
	- Cash Balance	283,680	37,505	0	0	0	0	0
		283,680	37,505	73,422	105,708	126,474	125,571	124,558
LIABILITIES		615,659	1,333,083	1,301,217	1,202,831	1,092,925	961,350	829,666
1.	Equity Capital	593,976	593,976	593,976	593,976	593,976	593,976	593,976
2.	Revenue Reserves	0	0	(252,188)	(510,766)	(756,606)	(983,470)	(1,190,758)
3.	Term Borrowings							
	- Foreign Currency Loan	21,683	739,107	831,773	665,418	499,063	332,708	166,353
	- Local Currency Loan	0	0	0	37,118	24,745	12,372	0
		21,683	739,107	831,773	702,536	523,808	345,080	166,353
4.	Current Liabilities							
	- Accounts Payable	0	0	11,184	17,737	22,074	21,976	21,857
	- Cash Shortfall	0	0	116,472	399,348	709,673	983,788	1,238,238
		0	0	127,656	417,085	731,747	1,005,764	1,260,095

APPENDIX 12-11

PROJECTED BALANCE SHEET : OPTION C

1. Assets

1.1 The figures quoted in respect of fixed assets reflect the value of the project investment by individual category, net of depreciation calculated at the rates specified in section 7.1 of Appendix 12-9.

1.2 The figures quoted in respect of accounts receivable, total inventory and cash in hand have been taken directly from the schedule detailing the working capital requirement in each year presented at Appendix 12-4.

1.3 For the purpose of the financial projections, it has been assumed that all cash surpluses reflected in the cash flow table at Appendix 12-10 would be retained as cash balances.

2. Liabilities

2.1 It has been assumed that there would be no change in the shareholding structure and, more specifically, no further increase in the issued and paid-up share capital to that detailed in the initial financing plan.

2.2 The figures quoted in respect of revenue reserves have been taken directly from the net income statement presented at Appendix 12-9, and reflect the accumulated loss position of the project.

2.3 Provision has been made for the foreign and local currency loans to be drawndown as per the initial financing plan detailed in Appendix 12-7, and to be repaid as specified in the cash flow table at Appendix 12-10.

2.4 The figures quoted in respect of accounts payable have been taken directly from the schedule detailing the working capital requirement in each year set out in Appendix 12-4.

2.5 The figures quoted in respect of the cash shortfall have been taken directly from the cash flow table presented at Appendix 12-10, and reflect the accumulated cash deficits of the project.

UNIDO PENICILLIN PROJECT : OPTION C

Appendix 12-12

CASH FLOW TABLE : TOTAL INVESTMENT

in Pesos '000

Year	0	1	2	3	4	5
CASH INFLOWS						
1. Sales Revenues	0	127,728	205,447	257,468	259,480	261,895
CASH OUTFLOWS	(1,295,578)	(307,829)	(289,918)	(334,752)	(316,956)	388,995
1. Total Investment Outlay	(1,295,578)	(125,127)	(25,733)	(16,429)	805	894
2. Residual Value of Assets	0	0	0	0	0	705,108
3. Operating Costs	0	(182,702)	(264,185)	(318,323)	(317,761)	(317,003)
4. Corporate Tax	0	0	0	0	0	0
NET CASH FLOW	(1,295,578)	(180,101)	(84,471)	(77,284)	(57,476)	650,894
Internal Rate of Return	-19.6%					
Net Present Value @ 19%	(1,099,445)					
Cumulative Net Cash Flow	(1,295,578)	(1,475,679)	(1,560,150)	(1,637,434)	(1,694,910)	(1,044,016)
Pay-Back Period	-					

UNIDO PENICILLIN PROJECT : OPTION C

Appendix 12-12

CASH FLOW TABLE : EQUITY CAPITAL

in Pesos '000

Year	0	1	2	3	4	5
CASH INFLOWS						
1. Sales Revenues	0	127,728	205,447	257,468	259,480	261,895
CASH OUTFLOWS	(593,976)	(249,244)	(499,708)	(551,364)	(534,400)	187,869
1. Equity Subscription	(593,976)	0	0	0	0	0
2. Replacement Investment	0	0	0	0	0	0
3. Residual Value of Assets	0	0	0	0	0	705,108
4. Debt Service :Repayments						
- Forex Loan	0	0	(166,355)	(166,355)	(166,355)	(166,355)
- Local Loan	0	0	0	(12,373)	(12,373)	(12,372)
5. Debt Service : Interest						
- Forex Loan	0	(66,542)	(59,888)	(46,580)	(33,271)	(19,962)
- Local Loan	0	0	(9,280)	(7,733)	(4,640)	(1,547)
6. Operating Costs	0	(182,702)	(264,185)	(318,323)	(317,761)	(317,003)
7. Corporate Tax	0	0	0	0	0	0
NET CASH FLOW	(593,976)	(121,516)	(294,261)	(293,896)	(274,920)	449,764

Internal Rate of Return	-36.5%
Net Present Value @ 19%	(862,950)

APPENDIX 12-12

CASH FLOW TABLES : OPTION C

1. Total Investment

1.1 The figures quoted in respect of sales revenues, operating costs and corporate taxation have been taken directly from the net income statement presented at Appendix 12-9.

1.2 The figures quoted in respect of the total investment outlay have been taken directly from the schedule presented at Appendix 12-5, and reflect the sum of the initial investment costs, pre-production capital expenditures and the increase in working capital requirements in each year. For the purpose of these calculations, the investment outlay in the project implementation phase has been combined as one total.

1.3 The residual value of the assets reflects the total book value of the fixed assets of the project in 1999, as per the projected balance sheet presented at Appendix 12-11.

2. Equity Capital

2.1 The figures quoted in respect of sales revenues, operating costs and corporate taxation have been taken directly from the net income statement presented at Appendix 12-9.

2.2 The figures quoted in respect of equity subscription have been taken directly from the initial financing plan set out in Appendix 12-7.

2.3 It has been assumed that there would be no replacement investment during the period under review.

2.4 The residual value of the assets reflects the total book value of the fixed assets of the project in 1999, as per the projected balance sheet presented at Appendix 12-11.

2.5 The figures quoted in respect of debt service (repayments and interest) have all been taken directly from the cash flow table for financial planning which is presented at Appendix 12-10.

PREFEASIBILITY STUDY

ON

THE ESTABLISHMENT OF AN INDUSTRIAL SCALE PENICILLIN PLANT

PROJECT NO DG/PHI/86/014
CONTRACT NO 91/80

on behalf of

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION
PO BOX 300
A-1400 VIENNA
AUSTRIA

FEBRUARY 1992

Manderstam Consulting Services
2/10 Harbour Yard
Chelsea Harbour
London SW10 0XD

Tel: 071 730 9224
Fax: 071 823 3056
Tlx: 24787 Mander G

THE ESTABLISHMENT OF AN INDUSTRIAL SCALE PENICILLIN PLANT

WORKING PAPERS - VOLUME III

MANDERSTAM	**CONSULTING ENGINEERS** 2/10 HARBOUR YARD CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page
		Made by	Rev.
		Checked by	Date

PROJECT

BASIS

Batch

hours

Shaw week

30%

MANDERSTAM	CONSULTING ENGINEERS 2 10 HARBOUR YARD, CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page
		Made by	Rev.
		Checked by	Date

PROJECT

6 APA → AMOXY TRIHYDRATE

216.28 419.5

$\xrightarrow{81\%}$ [illegible]

6 APA → CLOXACILLIN MONOHYDRATE

216.28 [illegible]

1 $\xrightarrow{0.8}$ [illegible]

OVERALL YIELDS

PEN G → 6 APA → CLOXACILLIN

1 0.54 0.95

[illegible] [illegible] 1

PEN G → 6 APA → AMPICILLIN

1 0.[illegible] 0.[illegible]

[illegible] 0.[illegible] 1

PEN G 6 APA AMOXYCILLIN

1 0.54 0.7855

[illegible] [illegible] 1

SUMMARY [illegible] RELATING TO PEN G

6 APA .55 [illegible] PEN G REQUIRED

AMPICILLIN 1.2 1.291 "

[illegible] [illegible] "

[illegible] [illegible] "

MANDERSTAM	**CONSULTING ENGINEERS** 2/10 HARBOUR YARD CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page
		Made by	Rev.
		Checked by	Date

PROJECT

[illegible] SUMMARY

CHART			
1	FORECASTED DEMAND	–	MARKET SURVEY CURRENT & FORECASTED [illegible] AS TONNE/YEAR PRODUCT
2	DERIVED DEMAND	–	[illegible]
3	FORECASTED [illegible]	–	[illegible]

CHART 1 Philippines Domestic Market

DEMAND FORECAST EX N MULLINEUX

Forecast Demand for Penicillins [illegible] UNITS = OF PRODUCT

TONNE PER YEAR ROUNDED

	[illegible] ANIMAL	[illegible] DOSE	[illegible] DOSE	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

originals sent RE/NM from C² 16th/Oct/91 WP4

CHART 3
(AMENDED)

Production Schedule (converted into Pen-G equivalent)

	Natural P'cillins	Pen-G Feed	Pen-G / Pen-V Human	6-APA	Bulk S-Synths	Ampi-cillin	Amoxy-cillin	Cloxa-cillin	Final Dosage	Ampi-cillin	Amoxy-cillin	Cloxa-cillin	Total Pen-G
1995	9	2	7	130.1	20	6	13	1	0.9	0.2	0.6	0.1	130
1996	19	4	15	157	30	8	20	2	2	0.5	1.4	0.1	209
1997	28	6	22	157.2	42	10	29	3	2.8	0.7	1.9	0.2	260
1998	38	8	30	156.3	52	12	36	4	3.7	0.8	2.6	0.3	260
1999	49	10	39	147.3	59	12	42	5	4.7	1	3.3	0.4	260
2000	45	10	33	181	67	12	45	5	5	1	3.6	0.4	297
2001	49	10	39	186.8	65	12	43	5	5.2	1	3.8	0.4	306
2002	49	10	33	184.7	67	11	50	6	5.3	1	3.9	0.4	306
2003	50	10	40	181.5	69	11	52	6	5.5	0.8	4.2	0.5	306
2004	50	10	40	178.3	72	11	55	6	5.7	0.9	4.4	0.5	306
2005	50	11	39	210.1	74	10	57	7	5.9	0.8	4.5	0.6	340
2006	51	11	40	213.0	78	10	60	8	6.2	0.8	4.8	0.6	349
2007	51	11	40	210.6	81	10	63	8	6.4	0.7	5	0.7	349
2008	52	11	41	206.4	84	10	65	9	6.6	0.7	5.2	0.7	349
2009	52	11	41	202	88	8	69	11	7	0.7	5.5	0.8	349
2010	52	11	41	197.8	92	8	73	11	7.2	0.7	5.7	0.8	349

Sales Forecast by Individual Product

	Natural P'cillins	Pen-G Feed	Pen-G / Pen-V Human	6-APA	Bulk S-Synths	Ampi-cillin	Amoxy-cillin	Cloxa-cillin	Final Dosage	Ampi-cillin	Amoxy-cillin	Cloxa-cillin
1995	9	2	7	54	17	5	11	1	0.8	0.2	0.5	0.1
1996	19	4	15	85	26	7	17	2	1.7	0.4	1.2	0.1
1997	28	6	22	101	35	8	24	3	2.4	0.6	1.6	0.2
1998	38	8	30	93	44	10	30	4	3.2	0.7	2.2	0.3
1999	49	10	39	80	50	10	35	5	4	0.8	2.8	0.4
2000	43	10	33	58	53	10	38	5	4.2	0.8	3	0.4
2001	49	10	39	101	55	10	40	5	4.4	0.8	3.2	0.4
2002	49	10	33	100	57	9	42	6	4.5	0.8	3.3	0.4
2003	50	10	40	98	59	9	44	6	4.7	0.7	3.5	0.5
2004	50	10	40	96	61	9	45	6	4.9	0.7	3.7	0.5
2005	50	11	39	114	63	9	48	7	5.1	0.7	3.8	0.6
2006	51	11	40	116	66	8	50	8	5.3	0.7	4	0.6
2007	51	11	40	114	69	8	53	8	5.5	0.6	4.2	0.7
2008	52	11	41	112	72	8	55	9	5.7	0.6	4.4	0.7
2009	52	11	41	109	75	7	58	10	6	0.6	4.6	0.8
2010	52	11	41	107	73	7	61	10	6.2	0.6	4.8	0.8

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD, CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page [illegible]
		Made by	Rev.
		Checked by	Date

PROJECT

DESIGN CAPACITY Fermenters

BASIS: to manufacture 1990 demand (124 ton/year)

PLUS 50% [illegible] increase

PLUS 20% allowance for engineering

PLUS [illegible]% allowance for losses in production

Example see WP 4 production schedule

AMOUNT: 100 m³ FERMENTER WP 1 net 2.584 tons after recovery

FERMENTATIONS PER YEAR WP 5 38 per fermenter

TONS PER FERMENTER [illegible] 97.8 tons
[illegible] 98 [illegible]

Number of fermenters required in service :–

YEAR	Prodn. Schedule	Fermenters required
1995 - 2000	237 tons	3
2000 - 2010	306 - 349 "	4

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD. CHELSEA HARBOUR LONDON SW10 OXD	Job No.	Page WP 6
		Made by	Rev.
		Checked by	Date

PROJECT

VESSEL CAPACITY

GROSS	m^3	50	75	100	125	150	
NET	m^3	42.5	64	86	106	127.5	
No. FERMENTERS							PRODN SCHED
1995		3	2	2	1	1	130 tons
2000		5.2	4.1	3.1	3	2	297
2005		7.1	5	4	3	3	340
2010		8	5	4	3	3	349

(basis 1250 x 0.9 = 1125 kg /year /m^3 capacity) WP 1

fermenter capacity	one fermenter tons ox	one fermenter ton/year net	
50 m^3	1.292	47.81	
75 "	1.938	72	37 batches/year
100	2.584	95.6	
125	3.23	119.25	
150 "	3.876	143.75	

SUMMARY (100 m^3 fermenter basis)

	Fermenters main 100 m^3	seed 3 m^3	Prodn Sched tons	Fermenters	maximum batches per year	max poss output tons net /year	design capacity tons
1995	3	3	130	3	111	286	
2000	4	4	297	4	148	382	320
2005	4	4	340	4	148	382	349
2010	4	4	349	4	148	382	355

design output net :—

1) 3 fermenters 85 m^3 net 100 m^3 gross capacity to 1999
4 " thereafter

2) 37 batches/year 2.592 tons gross o/p. 2,584 tons net.

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD. CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page
		Made by	Rev.
		Checked by	Date

PROJECT

MANDERSTAM	**CONSULTING ENGINEERS** 2/10 HARBOUR YARD. CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page
		Made by	Rev.
		Checked by	Date

PROJECT

Summary

[illegible] 150kW shaft 200 kW motor @ 1500 rpm

[illegible] 55 kW [illegible] @ 1000 rpm

[illegible]

65 [illegible]

[illegible]

[illegible] 0.0614 m/sec

[illegible] 0.20 [illegible]/sec

[illegible], unaerated power 365?kW

[illegible] = 1252 RPM

[illegible] aerated

[illegible] = 18.29 [illegible] = 100 kW

[illegible] speed 1500 top speed

[illegible] speed 1200 rpm

[illegible] = 186 kW

[illegible] → 108 kW

MANDERSTAM | **CONSULTING ENGINEERS**
2/10 HARBOUR YARD,
CHELSEA HARBOUR
LONDON SW10 0XD

Job No.	Page
Made by	Rev.
Checked by	Date

PROJECT

C

VESSEL/TANK
PROCESS DATA AND SPECIFICATION SHEET

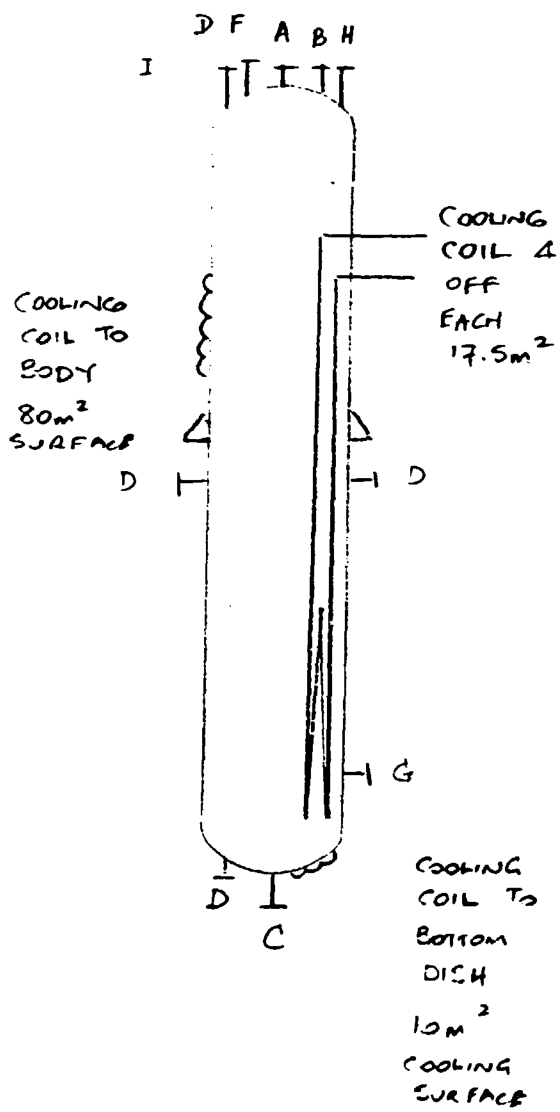
ITEM NO. 101/2/3

CLIENT: SHEET OF

SERVICE PRODUCTION FERMENTERS NO. OF UNITS 3

MATERIAL	316 SS
CENTRE LINE	
DIMENSIONS	3500 DIAM
	10000 OVER TAN LINES
CAPACITY	NOMINAL 100 cu m
MIN.CORROSION ALLOWANCE	AS WATER
FLUID	CORN STEEP LIQUOR
S.G.	1.07
FLASH POINT	N.A
	OPERATING DESIGN
TEMPERATURE °C	130°C
PRESSURE	1.75 barg
MIN. BASE ELEVATION	
INSULATION	NONE THICKNESS
INTERNALS	
RADIOGRAPHED SEAMS	LONG CIRCUM
CRACK DETECTION	
STRESS RELIEVED	
DESIGN CODE	ASME CLASS VIII DIVN 1
FLANGE RATING	ASA 150 lb
TEST PRESSURE	

SKETCH



FITTINGS

ITEM	NO.OFF	SIZE	DUTY
A	1	24"	AGITATOR PAD
B	1	8"	GAS OUTLET NECK
C	1	6"	OUTLET "
D	6	2"	INSTRUMENTS "
E	6	4"	FEED PIPE
F	1	6"	" "
G	1	6"	AIR INLET
H	1	18"	MANHOLE
I	1	8"	SIGHT GLASS
J			
K			
L			
M			
N			

WELDS GROUND SMOOTH CRACK & CREVICE FREE

REV	MADE	CHKD.	APP.	DATE
0	RLS			9.9.91
1				
2				
3				
4				

MANDERSTAM

CONSULTING ENGINEERS
2/10 HARBOUR YARD,
CHELSEA HARBOUR
LONDON SW10 0XD

PROJECT ANTIBIOTIC PROJECT PHILIPINES.

SHIPPING SPEC.	NO. CRATES	GROSS WT.	NETT WT.	DIMENSIONS

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page
		Made by RLS	Rev.
		Checked by	Date 9.9.91

PROJECT PHILIPPINE ANTIBIOTIC AGITATOR ENQUIRY

Number off	3, Pos. Nos 204, 205, 206
Service	Penicillin G Fermentation
Motor power kW	200 2-speed motor.
turbines	Rushton 3 off.
Fermenter	
diameter	3500
height	10500
working volume m^3	85
total volume m^3	100 nominal.
Fluid sg	1.07, corn steep liquor.
air rate	0.7 v/v/min
broth temperature	25°C
vessel pressure maxium	1.6 barge during sterilsation
" " operating	0.5 barge at top
vessel temperature max	130°C during sterilisation
" " operating	25°C
material construction	316 stainless steel
mechanical seal	double
steady bearing	glass filled ptfe
electrical supply	380 v 60 cy 3 phase

WP 12

VESSEL/TANK
PROCESS DATA AND SPECIFICATION SHEET

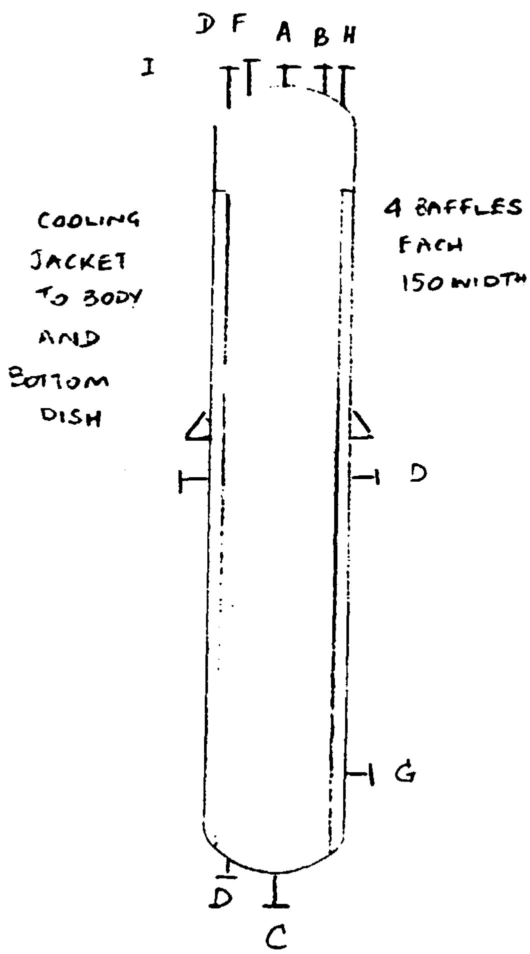
ITEM NO. 104/5/6

CLIENT: SHEET OF

SERVICE SEED FERMENTERS NO. OF UNITS 3

MATERIAL	316 SS	
CENTRE LINE		
DIMENSIONS	1750	DIAM
	5250	OVER TAN LINES
CAPACITY	NOMINAL 10 cu m	
MIN.CORROSION ALLOWANCE	AS WATER	
FLUID	CORN STEEP LIQUOR	
S.G.	1.07	
FLASH POINT	N.A	
	OPERATING	DESIGN
TEMPERATURE °C		130°C
PRESSURE		1.75 barge
MIN. BASE ELEVATION		
INSULATION	NONE	THICKNESS
INTERNALS		
RADIOGRAPHED SEAMS	LONG	
	CIRCUM	
CRACK DETECTION		
STRESS RELIEVED		
DESIGN CODE	ASME CLASS VIII DIVN 1	
FLANGE RATING	ASA 150 lb	
TEST PRESSURE		

SKETCH



FITTINGS

ITEM	NO.OFF	SIZE	DUTY
A	1	8"	AGITATOR PAD
B	1	3"	GAS OUTLET NECK
C	1	2"	OUTLET "
D	6	1"	INSTRUMENTS "
E	6	2	FEED PIPE
F	1	2	" "
G	1	2	AIR INLET
H	1	18	MANHOLE
I	1	8	SIGHT GLASS
J			
K			
L			
M			
N			

WELDS GROUND SMOOTH CRACK & CREVICE FREE

WP 6 WP 7

REV	MADE	CHKD.	APP.	DATE
0	RLS			9.9.91
1				
2				
3				
4				

MANDERSTAM

CONSULTING ENGINEERS
2/10 HARBOUR YARD.
CHELSEA HARBOUR
LONDON SW10 0XD

PROJECT ANTIBIOTIC PROJECT PHILIPPINES.

SHIPPING SPEC.	NO. CRATES	GROSS WT.	NETT WT.	DIMENSIONS

MANDERSTAM	CONSULTING ENGINEERS 7/10 HARBOUR YARD CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page
		Made by RLS	Rev.
		Checked by	Date 9.9.91

PROJECT PHILIPPINE ANTIBIOTIC AGITATOR ENQUIRY

Number off	3, posn. nos 207, 208, 210
Service	seed fermenters Penicillin G
Motor power kW	20
turbines	Rushton 3 off
Fermenter	
diameter	1750
height	5250 tan-to-tan
working volume m^3	$8{\cdot}5 m^3$
total volume m^3	$10 m^3$ nominal.
Fluid sg	1·07 corn steep liquor
air rate	0·7 v/v/min
broth temperature	25°C
vessel pressure maximum	1·6 barg during sterilisation
" " operating	0·5 barg at vessel head.
vessel temperature max	130°C during sterilisation
" " operating	25°C
material construction	316 stainless steel
mechanical seal	double
steady bearing	glass filled ptfe
electrical supply	380 v 60 Hz 3 phase

MANDERSTAM

CONSULTING ENGINEERS
2/10 HARBOUR YARD,
CHELSEA HARBOUR
LONDON SW10 0XD

Job No.	Page VP
Made by	Rev.
Checked by	Date

PROJECT

[illegible] contd. [illegible]

[illegible] Each coil [illegible]

[illegible] 500 mm [illegible]

[illegible] $= 3.8\,m^2$

[illegible] approx [illegible]

[illegible] 24

[illegible] m^2 [illegible]

[illegible] m^2

[illegible] $20\,m^2$

[illegible]

		l/m^2 min	Year	l/m^2 min Total
[illegible]	[illegible] 00 m^2 [illegible]	65 × 3	-	195
	0 m^2	6.5 × 3		19
[illegible]	[illegible]			214
		increase 1×100 m^2 1×10 m^2		285
		no further increase		285

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD. CHELSEA HARBOUR LONDON SW10 OXD	Job No.	Page 5
		Made by	Rev.
		Checked by	Date

PROJECT

300

35 m³ 85 m³

PLANT BASIS 1995 (5m³ per ...)

3160 × 3 / 215.5

1.0
2.5
210.0
2.0
215.5

CENTRIFUGAL COMPRESSOR

PROCESS DATA AND SPECIFICATION SHEET

ITEM NO. 201

CLIENT PHILIPPINE ANTIBIOTIC PROJECT	SHEET OF
SERVICE MAIN COMPRESSED AIR	NO. OF UNITS as appropriated
SERVICE CONDITIONS	DRIVER MOTOR
FLUID COMPRESSED AIR	TYPE STEAM TURBINE/ELECTRIC MOTOR
MOLECULAR WT.	RANGE OF CONTROL
NORMAL DESIGN	HEIGHT ABOVE SEA LEVEL 100m
CAPACITY 1995 220 Nm³/min initial	DISTANCE OF AIR FILTER
EQUIVALENT CAP 285 Nm³/min final	COMPRESSOR FROM EXHAUST OUTLET
SUCTION VOL (V1)	POWER VOLT NK PHASE 3 CYCLE 60
SUCT.PRESS (P1) atmospheric	SUPPLY
SUCT.TEMP. (T1) 30°C	STEAM SUPPLY PRESS NA
DISCH VOL. (V2)	TEMPERATURE
DISCH PRESS (P2) 2.5 barg	QUALITY
DISCH TEMP. (T2) 25°C	IS IT BACK PRESSURE
RATIO Cp/Cv	IS IT CONDENSING

SPECIFICATION

COMPRESSOR	DRIVER
TYPE screw - centrifugal	ELECTRIC MOTOR SPEED
SIZE	BHP ABSORBED NORMAL DESIGN
NO.STAGES	MOTOR RECOMMENDED
1st CRITICAL SPEED	TYPE
2nd CRITICAL SPEED	STARTING TORQUE REQUIRED
TYPE OF SEALING GLAND	TYPE OF STARTER
GEARBOX COMPRESSOR INTEGRAL/SEPARATE	GEARBOX
SURGE POINT	STEAM TURBINE SPEED NORMAL DESIGN
THRUST T.BEARING/DUMMY PISTON	BHP ABSORBED NORMAL DESIGN
COMPENSATION BALANCED INLET	MAX.CONTINUOUS RATED POWER
COMPRESSOR SPEED	MAX.CONTINUOUS RATED SPEED
ROTATION CLOCKWISE/ANTI-C.WISE LOOKING	ALL ROTATING PARTS TO BE GUARDED
ON COMPRESSOR FROM MOTOR/FLYWHEEL END	TO COMPLY STRICTLY WITH BSS

COOLERS

STAGE 1 2	Notes:
FLUID INLET TEMP. T.B.A.	1) air supply to fermentation
FLUID INLET PRESS.	requires sterilizing using
FLUID OUTLET TEMP.	Domnick Hunter filters
FLUID OUTLET PRESS.	
COLD WATER REQ.	2) air wanted oil + water free
COLD WATER TEMP.RISE	
OIL COOLER	COLD WATER TEMP. 16°C Available
CASING AND OTHER COLD WATER	COLD WATER MAX. PRESS
TOTAL COLD WATER	MOTOR COOLING REQUIREMENTS

GENERAL

HYDRAULIC TEST PRESS.	LUBRICATING OIL REQUIRED
MFR.TO SUPERVISE ERECTION YES/NO	FOUNDATION BOLTS INCLUDED YES/NO
WITNESS TESTS REQUIRED	

SPECIAL FITTINGS: COOLING WATER FAILURE ALARM/CUTOUT LOW SUCT.PRESS.ALARM/CUTOUT HIGH DISCH PRESS. ALARM/CUTOUT, EMERGENCY OIL PUMP

REV.	MADE	CHKD.	APP.	DATE
0	RLS	9.9.91		
1				
2				
3				
4				

MANDERSTAM CONSULTING ENGINEERS
2/10 HARBOUR YARD,
CHELSEA HARBOUR
LONDON SW10 OXD

SHIPPING SPEC	NO. CRATES	GROSS WT.	NETT WT.	DIMENSIONS

MANDERSTAM	**CONSULTING ENGINEERS** 2. 10 HARBOUR YARD, CHELSEA HARBOUR LONDON SW10 OXD	Job No.	Page
		Made by	Rev.
		Checked by	Date

PROJECT [illegible]

[illegible]

[illegible] 4620 [illegible]

[illegible]

POWER [illegible] KW

	1995 KW	2000-5
[illegible]	200	200
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD, CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page 18
		Made by	Rev.
		Checked by	Date

PROJECT

Summary. Implementation

	1995	2000-5
[illegible]	70 m^3/h	85 m^3/h
[illegible]	70 kg/h	86 kg/h
[illegible]	[illegible]	[illegible]
[illegible]	[illegible] kW	3000 kW

	1995	2000	2005
[illegible]	[illegible]	367	[illegible]
[illegible]	382 [illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

	1995-2000	2000-2005	2005-
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	70	85	100

BALANCE

[illegible]				30.[illegible]
[illegible]	[illegible]			96.30
[illegible]	2	[illegible] - 215	0.5	77.04
[illegible]		[illegible]		
[illegible]		15		[illegible]
				17[illegible]

[illegible] proportion [illegible]

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD, CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page
		Made by	Rev.
		Checked by	Date

PROJECT

FERMENTATION

23.87

20 000

55

51 kW

255

228,400 L

50

26

70 m^3

m^3

MANDERSTAM	**CONSULTING ENGINEERS** 2/10 HARBOUR YARD, CHELSEA HARBOUR LONDON SW10 OXD	Job No.	Page 18 B
		Made by	Rev. 2
		Checked by	Date

PROJECT UTILITY PENICILLIN G

OVERALL CONSUMPTION UTILITIES

				PER BATCH	PER HOUR (3 BATCH BASIS)	INSTALLED
STEAM						
	Media sterilisation		tons	6		
ullman	other, misc			113		
	extraction			1		
	total			120	1.65	15
POWER						
WP 18A	fermentation compressors refrigeration		MW	228.4		
WP 52	extraction	WP 52	MW	50.5		
	total		MW	279	3.9	3
WATER						
WP 18A	fermentation cooling water		m^3	65		
	extraction			70		
				135	2.58	6

UTILITY COSTS

			pesos / batch
Bunker	5.317		
Power	2220	Pesos / MWh	619 280
City water	3.17	/ m^3	428
Steam	600	/ tonne	72 000
Total			691, 708

OPERATING COSTS UTILITIES

	BATCHES		
1995	51	35.28	Pesos $\times 10^6$/year @ 691,708 P/bx
1996	81	56.03	
1997 - 9	[illegible]	[illegible]	
2000	[illegible]	[illegible]	
2001 - 4	[illegible]	[illegible]	
2005	[illegible]	[illegible]	
06 - 0	[illegible]	[illegible]	

See also WP 77, 78, 79 for all utility usage for options I II and III

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page
		Made by	Rev.
		Checked by	Date

PROJECT

N° 3

	ENG	X	required	
	130	51		
	208	31		
		01		

(1) 2. (3) (4) (5) (6)

34.2

-1574-

(N° 3)

MEDIUM		BATCH %	BATCH kg	PESOS/TONNE	$ US/TONNE	1 2507 tonne	1 2507 / BX	$/kg , 26 %	+ 2,584	Pesos chuck Pesos / 51 batches
CORN STEEP LIQUOR	RAW 50%	66.7	60,633	5900	-	5900	539,633	8.0	32.9%	27521
CALCIUM CARBONATE	PPTD	16.7	15157	-	270	7019	106 386	1.58		5425
SODIUM SULPHATE	TECH	10.5	9549	-	146	3795	36,409	.54		1856
POT HYDROG PHOSPHATE	"	1.0	909	-	1992	51785	47 072	0.70		2400
SOY BEAN OIL	DISTILLED	1.0	4729	21,000	-	21000	99 309	1.48		5,065
TOTAL PER BX		100	90950	NA	NA					
FEEDINGS										
AMMONIUM SULPHATE (17% SOL)	TECH	8.5	7650	-	26.25	682	5,217	0.08		266
AMMONIA	GAS	1.0	940	-	184	4783	4,496	0.06		229
CAUSTIC POTASH	FLAKE	-		-	-					
SULPHURIC ACID (35% SOL)	35%	1.6	1440	-	35	900	1,310	0.02		67
SOY BEAN OIL	DISTD	1.4	1260	21,000	-	21000	26,460	0.39		1349
SOY BEAN PPG	60:40 MIX	-	-	-	-					
SUCROSE SOLN (50% SOL)	FOOD	56	50400	3675	-	3675	185,220	2.76	11.3%	9446
PHENYL ACETIC ACID (15% SOL)	TECH	11	9900	-	1086	28232	279,496	4.16	17.1%	14254
WATER		19.1	18500	-	-	-	-			-
TOTAL PER BX		100								
EXTRACTION										
BUTYL ACETATE	TECH		5,530	-	1500	38,995	215,642	3.2		10997
CARBON	ACTIVE		16.65	-	996	25892	431	neg		22
SOD BI CARB	TECH		809	-	881	22903	18528	0.27		945
BUTANOL	"		2390	-	1166	30312	72,445	1.08		3694
								24.32		83,536
							pesos/bx	24 72		1687.9
							$ bx			62.
							$ kg			24.3

ALL PRICES CORRECTED FOR DILUTION AS APPROPRIATE
DELIVERED TO SITE

US $ PRICES 10% DUTY PAID

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page WP 21
		Made by	Rev.
		Checked by	Date

PROJECT

FERMENTATION MATERIAL SPECS & COSTS

	GRADE	QUOTED	CIF MANILA	DUTY %	LOCALLY PRODUCED IN US DOLLARS OR PESOS/TONNE DELIVERED	IMPORTED US $/ TONNE DELIVERED DUTY PAID	
CORN STEEP LIQUOR 6-7% TS	RAW	1·2 P/kg	–				
" " 50% TS	"	–	8.6 P/kg	0	P 5900 ✓	–	
CALCIUM CARBONATE	PRECIPTD	212 $/ton ✓	233 $/ton	10	–	270 ✓	
SODIUM SULPHATE	TECH	115 $/ton ✓	126 $ "	10	–	146 ✓	
POT HYDROGEN PHOSPHATE		·70 $/100 lb	77 $/100 lbs	10	–	1552	
SOY BEAN OIL	RAW	20 P/kg	20 P/kg	0	P 21,000	–	
" " "	"	21¢/lb					
AMMONIUM SULPHATE	TECH	$ 122/ton ✓	134 $/ton	10	–	155 ✓	
AMMONIA GAS	ANHYD	$ 145/ton ✓		3	–	187 ✓	
AMMONIUM HYDROXIDE 30%	TECH	$ 260/ton ✓	286 $ ton		NA	330	
CAUSTIC POTASH (SODA)	PURE FLAKE (90%)	$ 45/100 lb ✓	50 $/100 lb	10	–	1280 ✓	
SULPHURIC ACID	PURE	$ 80/ton ✓	88 $/ton	0	$ 84	101	
POLYPROPYLENE GLYCOL	TECH	(c) $ 1/lb	1 $/lb	10	–	2850	?
SUCROSE (L)	FOOD (US)	$ 36/100 lbs ✓	7000 P/tonne ?	0	P 7350 check %	1027	
PHENYL ACETIC ACID SALT	TECH	NK	6 $/kg ?	10	–	7620	
SOYBEAN OIL/MEAL	44% PROTEIN	$ 163/ton	180 $/ton	0	$ 188	$ 207 ✓	
" " OIL Distilled	RAW	$ ·21/lb		0		$ 597 ?	(1230)
GLUCOSE SOLN 82-7% DS	35/45 DE		NA	NA	–	–	
DEXTROSE HYDRATED		25 $/100 lb ✓	NA	NA	–		
MAGNESIUM SULPHATE	TECH	0·16 $/lb	NA	10	–	369	(455)
PALM OIL REFINED (L)	TECH	?? 25 $/lb	NA	0	?	840 ?	
PHENYL ACETIC ACID	REFINED/TECH	4·75 $/kg	5·2 $ kg	10	–	6035	
BUTYL ACETATE	TECH	0·50/lb				1423	
BUTANOL	"	0·41/lb				1167	
SODIUM BI CARBONATE	"	$ 19/100 lb				540	
ACTIVE CARBON	"	Each ·32/lb				911	

1.2705

US $ CIF NY × 1.1 = CIF MANILA, CIF MANILA × 1·1 × 1.05 = DUTY PAID DELIVERED MANILA

WP 21A

Estimation of cost of 50% CSL

6% CSL = 1-2 pesos / kg

	6% CSL		50% CSL
water	940 kg	water	60
solids	60	solids	60
total	1000		120

water removed 940-60 = 880 kg.

assume 2 kg steam / kg water evaporated

cost to remove 880 kg at 600 Pesos / tonne

= 0.880 × 2 × 600 = 1056 pesos

ie To produce 120 kg costs P 1056 to evaporate

ie P per ton $\frac{1056}{120} \times 1000 =$ 8816 Pesos / tonne

add solids ×3 " "

8900 " "

WP 22

1 OF 2

ROBIN

TARIFFS ARE RATHER MORE COMPLICATED THAN I THOUGHT.

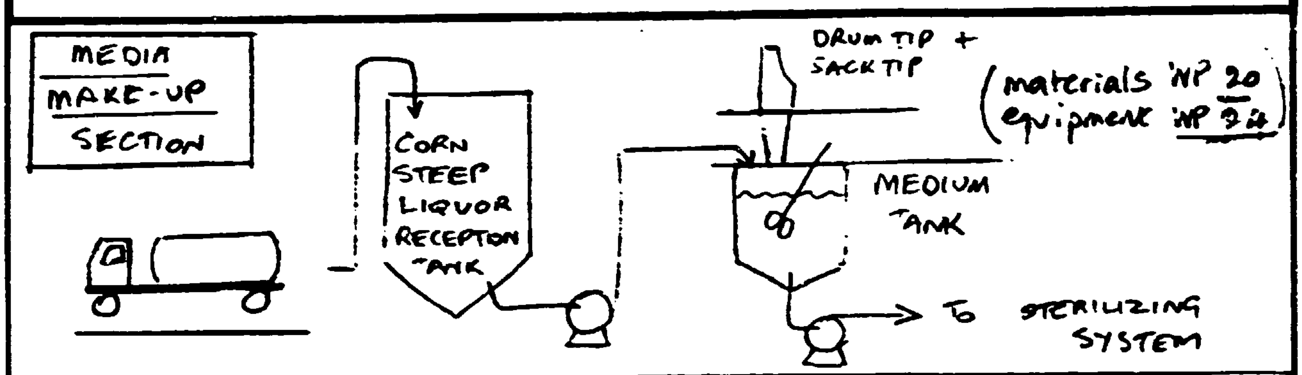
I ENCLOSE THE FOLLOWING RATES FOR YOU

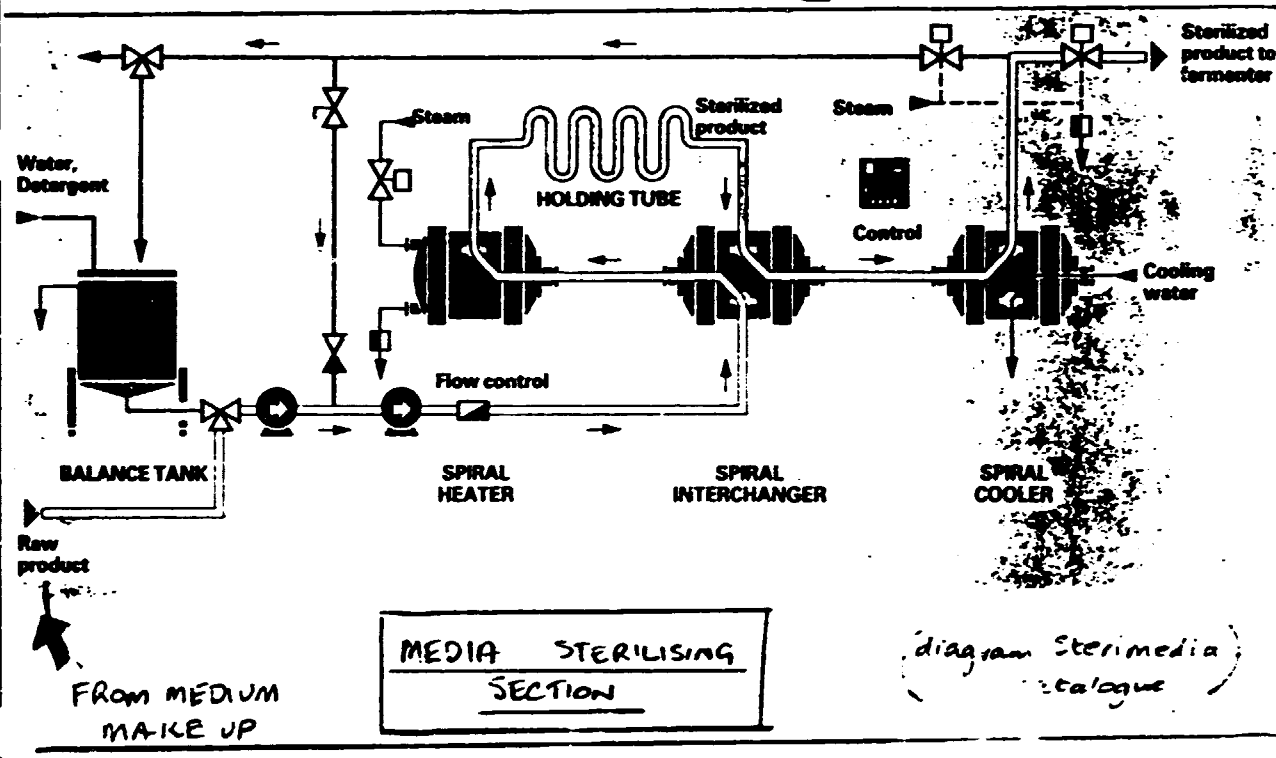
MATERIAL	TARIFF CODE	RATE	DESCRIPTION
CALCIUM CARBONATE	2836-50-00	10%	CALCIUM CARBONATE
SODIUM SULPHATE	2833-11-00	10%	DISODIUM SULPHATE
	2833-19-00	10%	OTHER SODIUM SULPHATE
POT HYDROGEN PHOSPHATE	2835-24-00	10%	PHOSPHATE OF POTASSIUM
...MMONIUM SULPHATE	2833-29-00	10%	OTHER SULPHATES
AMMONIUM HYDROXIDE	2814-10-00	3%	ANHYDROUS AMMONIA
	2814-20-00	10%	AMMONIA IN AQUEOUS SOLUTION (ONLY HYDROXIDES ARE SODIUM, POTASSIUM, MAGNESIUM, STRONTIUM AND BARIUM + AL
CAUSTIC POTASH	2815-20-10	10%	POTASSIUM HYDROXIDE SOLID
	2815-20-90	20%	" " OTHER
SULPHURIC ACID	2807-00-00	20%	SULPHURIC ACID, OLEUM
SOYA BEAN OIL *	1507-90-10	50% → 30%	SOYA BEAN OIL REFINED AND SOLIDIFIED " HARDENED BY MECH MEANS
	1507-90-90	20%	SOYA BEAN OIL REFINED, OTHER
SOYA BEAN MEAL	1208-10-00	30%	FLOUR AND MEAL OF SOYA BEANS
PALM OIL	1511-10-00	50%	PALM OIL AND FRACTIONS - CRUDE OIL
	1511-90-00	50%	" " " " - OTHER
GLUCOSE	1702-30-00	10%	GLUCOSE CONTAINING < 20% FRUCTOSE
	1702-40-00	10%	" " 20%-50% FRUCTOSE
SUCROSE	1701-	50%	VARIOUS DESCRIPTIONS OF CANE AND BEET SUGAR. NO SPECIFIC REFERENCE TO SUCROSE

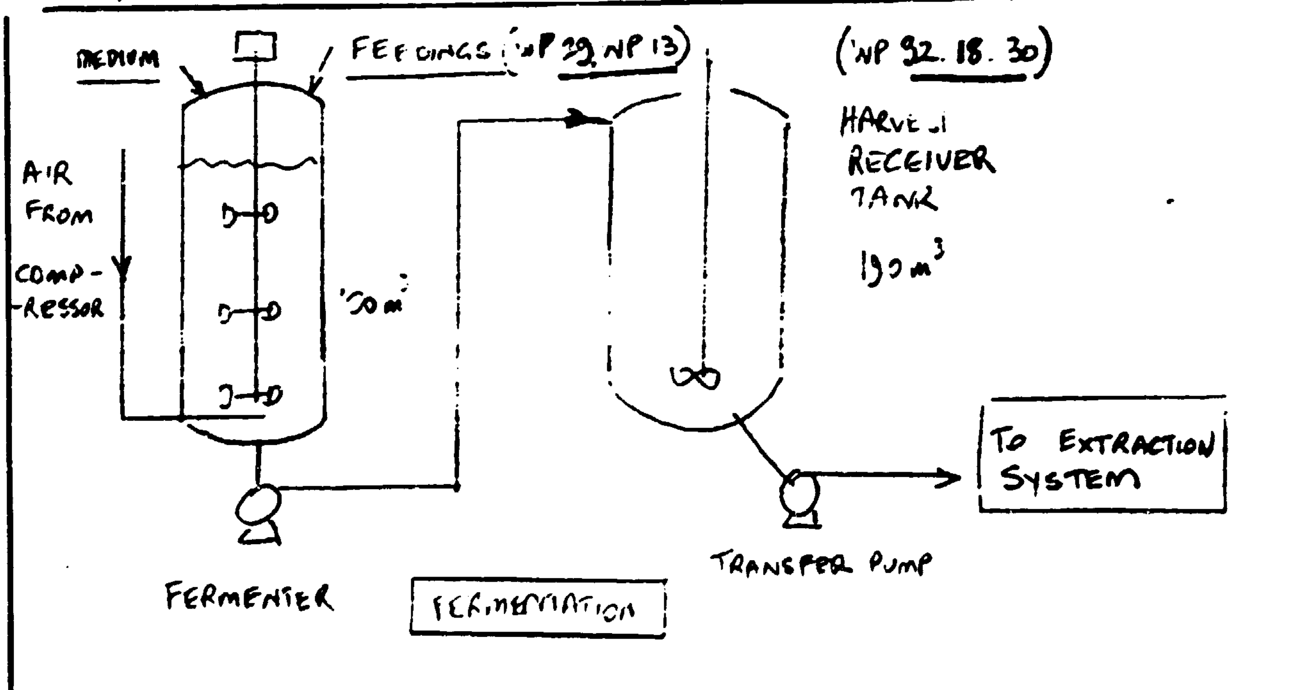
* 1/7/91 50%
1/7/92 45%
1/7/93 40%
1/7/94 [illegible]

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD, CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page WP23
		Made by	Rev.
		Checked by	Date

PROJECT FERMENTATION : FLOW SCHEME







Media Preparation Section | Eng Handout 12/6/91 Diagram 1

UNIDO - Philippines | Penicillin G | Equipment List

ITEM REF	Description of item.	Capacity or size	Mat of Const	No. off	Quoted yes	Quoted no	$ price
MP 1	Corn steep liquor reception tank	$120 m^3$	316	1		no	
MP 2	Corn steep liquor delivery pump, centrifugal, 2 barge	$50 m^3/h$	"				
MP 3	Bag opening machine Chronos Richardson	60 bag/hr	"			no	35,000
MP 4	Weigh hopper	$2 m^3$	316				
MP 5	Media make up tank	$100 m^3$	316				
MP 6	Media delivery pump, centrifugal, 2 barge	$50 m^3/hr$	316				
MP 7	Media Sterilisation plant Alfa Laval, Chemap		316		yes		425,000
MP 8	Drum emptying pump	$2 m^3/hr$	316				

requested Alfa Laval Chemap 12/1/91 KLJ

WP 24

ADDITIVE PREPARATION (AP) (Diagram)

UNIDO - Philippines — Penicillin G — Equipment List

ITEM REF	Description of item.	Capacity or size	Mat of const^n	No. off	Quoted yes	Quoted no	$ price
AP 1	sucrose vessel and agitator	2000	316	2		no	
AP 2	phenyl acetate preparation vessel + agitator	1000	316	2			
AP 3	ammonium sulphate preparation vessel + agitator	2000	316	2			
AP 4	soya preparation vessel + agitator	2000	316	2			
AP 5	caustic solution preparation vessel + agitator	2000	C.S.	2			
–	air filter	500 l/h	316	10			
–	air prefilter	"	316	10			
–	Make-up tanks :-						
	sucrose	$30m^3$	316	1			
	phenylacetate	$10m^3$	"	1			
	ammonium sulphate	$15m^3$	"	1			
	soya oil	$10m^3$	"	1			

PENICILLIN FERMENTERS (PF) Diagrams

UNIDO - Philippines Penicillin G Equipment List

WP 26

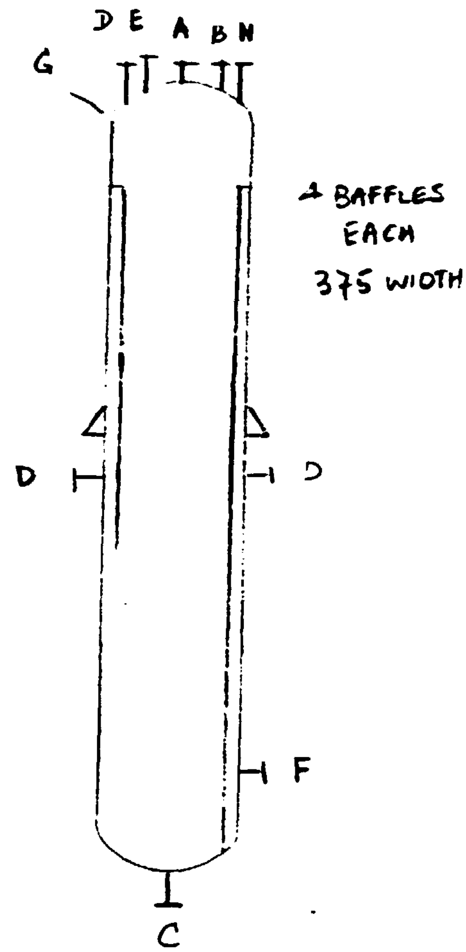
ITEM REF	Description of item.	Capacity or size	Mat of const^n	No. off	Quoted yes	Quoted no	$ price
PF 1	Fermenter	$100 m^3$	316	3 *	✓		600,000
PF 2	Fermenter agitation	200kW	316	3 *	✓		425,000
PF 3	Air sterilizer. + steam sterilizer	65 Nm^3/min	316	3 *	✓		306,000
PF 4	Seed fermenter	$10 m^3$	316	3 *	✓		67,320
PF 5	Seed fermenter agitator	20kW	316	3 *	✓		81,600
PF 6	Seed fermenter air sterilizer	Nm^3/min 6.5	316	3 *	✓		31,000
PF 7	pilot plant fermenter Chemap					✓	500,000
PF 8	Control scheme Rosemount	NA.	NA	1	✓		515,000
PF 9	Fermenter discharge pump (can be optional use air to blow)	$50 m^3$/h	316	3 *		✓	

* 4 required after 1999.

WP 28

VESSEL/TANK
PROCESS DATA AND SPECIFICATION SHEET — ITEM NO. 107

CLIENT:		SHEET	OF
SERVICE	FERMENTER HARVEST TANK	NO. OF UNITS	1
MATERIAL	316 SS	SKETCH	
CENTRE LINE			
DIMENSIONS	4500 DIAM		
	12000 OVER TAN LINES		
CAPACITY	NOMINAL 200 cum		
MIN.CORROSION ALLOWANCE	AS WATER		
FLUID	CORN STEEP LIQUOR		
S.G.	1.07		
FLASH POINT	N.A		
	OPERATING DESIGN		
TEMPERATURE °C	130°C		
PRESSURE	1.75 barge		
MIN. BASE ELEVATION			
INSULATION	NONE THICKNESS		
INTERNALS			
RADIOGRAPHED	LONG		
SEAMS	CIRCUM		
CRACK DETECTION			
STRESS RELIEVED			
DESIGN CODE	ASME CLASS VIII DIVN 1		
FLANGE RATING	ASA 150 lb		
TEST PRESSURE			



FITTINGS

ITEM	NO.OFF	SIZE	DUTY
A	1	20"	AGITATOR PAD
B	1	8"	GAS OUTLET NECK
C	1	8"	OUTLET "
D	3	2"	INSTRUMENTS "
E	1	6"	FEED PIPE
F	1	4"	AIR INLET
G	1	18"	MANHOLE
H	1	8"	SIGHT GLASS
I			
J			
K			
L			
M			
N			

WELDS GROUND SMOOTH CRACK & CREVICE FREE

(SEE WP 25)

REV	MADE	CHKD.	APP.	DATE
0	RLJ			9.9.91
1				
2				
3				
4				

MANDERSTAM
CONSULTING ENGINEERS
2/10 HARBOUR YARD.
CHELSEA HARBOUR
LONDON SW10 0XD

PROJECT ANTIBIOTIC PROJECT PHILIPPINES.

SHIPPING SPEC.	NO. CRATES	GROSS WT.	NETT WT.	DIMENSIONS

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD, CHELSEA HARBOUR LONDON SW10 OXD	Job No.	Page WP 29
		Made by	Rev.
		Checked by	Date

PROJECT FERMENTATION VESSEL & PUMP CAPACITY

Broth output total / fermenter 166 m^3 (WP 18)

Batch time 215.5 hours (WP 1)

HARVEST FREQUENCY

each fermenter discharges 166 m^3 every 215.5 hours

3 fermenters " 166 m^3 every 215.5/3 = 71.7 hours

4 " " " " 215.5/4 = 53.8 "

TRANSFER PUMPS size m^3/h

broth to fermenter 85 m^3 in 2.5h 40 (WP 1)

fermenter emptying 84 m^3 in 2 h 50 (WP 1)

HARVEST RECEIVER TANK

calculated capacity 190 m^3 (WP 18, 30, 32)

EXTRACTION THROUGHPUT (DESIGN CAPACITY BASIS)

			1995	2000	2005
WP 5	benzylpenicillin	ton/year	312	367	419
WP 15	no batches / year		113	150	150
	batch volume	m^3	166	166	166
	batch time	hours	215.5	215.5	215.5
	frequency of emptying	hours	71.7	53.8	53.8

Extraction design throughput :-

			1995	2000	2005
3 shifts	average	m^3/h	2.31	3.08	3.08
2 shifts	"	"	3.46	4.62	4.62
1 shift	"	"	6.93	9.24	9.24

EXTRACTION RATED O/PUT	1995	2000 – 2005
basis 2 shift working	4.0 m^3/h	5.0 m^3/h

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD, CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page 1/1 P 30
		Made by	Rev.
		Checked by	Date

PROJECT

(BASIS 3 FERMENTERS)

RE-CHECK HARVEST RECEIVER-TANK SEQUENCES

Filling 94 m^3 every 72 (71.7h) 3 fermenters
plus 1 m^3/h withdrawls

Emptying to extraction 4 m^3/h 16 hours / day

Check: assume vessel full 160 m^3

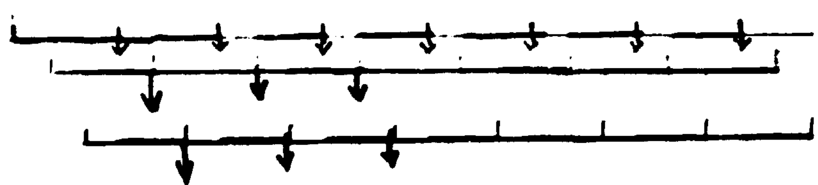
day	emptying	filling	m^3 loss (gain)	m^3 in tank
0	–	–		160
1	16 x 4 = 64 m^3/day	24 x 1 = 24 m^3	40	120
2	" " " "	" " "	"	80
3	" " "	{24 x 1 = 24 m^3 (+ 94 m^3 batch}	(54)	134
4	" "	24 x 1 = 24	40	94
5	" " "	" "	"	54
6	" " "	{" " " (+ 94 m^3 batch}		108

OK

SUMMARY

Harvest receiver 160 m^3 OK use 190 m^3

fermenter | batch cycle



2

3

Total batch time 9 days each

Scheme – fermenters. ↓ Each discharges 94 m^3 every 3 days plus 72 m^3 over days 4 to 9.

—— Period of withdrawls 2 fermenters

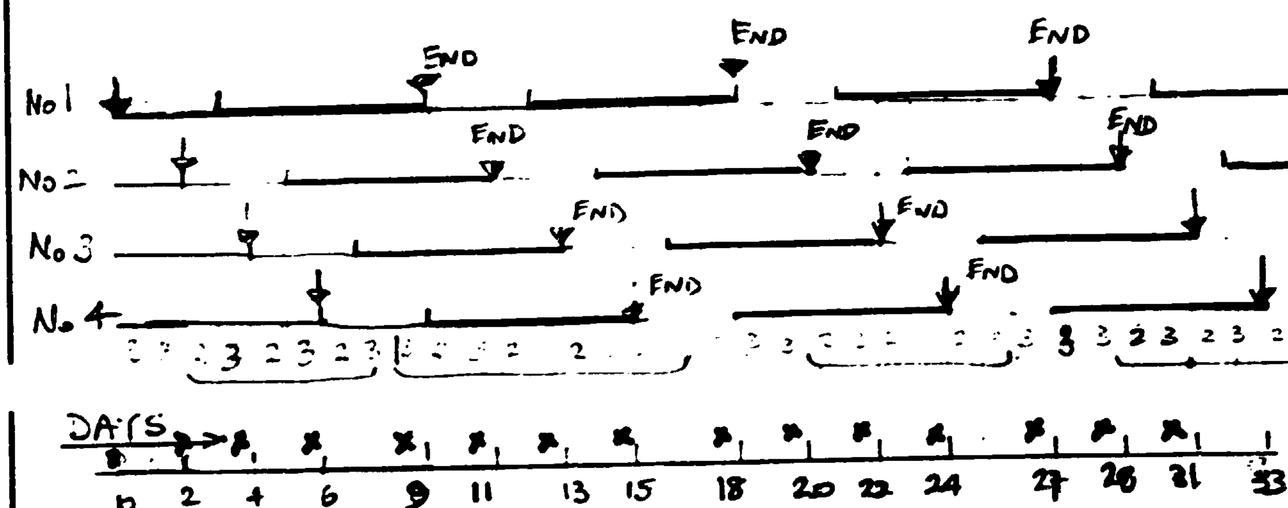
MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page
		Made by	Rev. WP 3
		Checked by	Date

PROJECT

HARVEST RECEIVER TANK CAPACITY (BASIS 4 FERMENTERS)

Filling: $94\,m^3$ every 48 hours plus withdrawals from 3 fermenters @ flow 72% $0.5\,m^3$ each

FERMENTER OPERATION - 4 FERMENTER BASIS



Assumptions

- Batch cycle 9 days
- Withdrawals last [illegible] 2 days
- Maximum discharge rate 1 batch every 2 days
- Maximum withdrawals - 3 fermenters at any one time
- [illegible] 1½ per 24.

MANDERSTAM	**CONSULTING ENGINEERS** 2/10 HARBOUR YARD CHELSEA HARBOUR LONDON SW10 OXD	Job No.	Page WP 32
		Made by	Rev.
		Checked by	Date

PROJECT

DAY	note 1 EMPTYING m^3	note 2 FILLING m^3	note 3 FILLING m^3	TOTAL FILLING m^3	m^3 LOSS GAIN	m^3 LOSS GAIN ACCUM
0						
1	80	0	36	36	−44	−44
2	"	94	36	130	+50	6
3	"	0	24	24	−56	−50
4	"	94	36	130	+50	0
5	"	0	24	24	−56	−56
6	"	94	36	130	+50	−6
7	"	0	24	24	−56	−62
8	"	0	36	36	−44	−106
9	"	94	36	130	+50	−56
10	"	0	36	36	−44	−100
11	"	94	[illegible]	130	50	−50
12	"	0	24	24	−56	−106
13	"	94	36	130	50	−56
14	"	0	24	24	−56	−112
15	"	94	36	130	[illegible]	−62
16	"	0	36	36	−44	−106
17	"	0	36	36	−44	−150
18	"	94	36	130	50	−100
19	"	0	36	36	−44	−144
20	"	94	36	130	50	−94
21	"	0	24	24	−56	−150
22		94	36	130	50	−100

" withdrawals 0.5 × 24 = 12 m^3 24 hours per fermenter

days	1	2	3	4	5	6	7	8	9	10	11	12	13	14
m^3 withdrawals	36	36	24	36	24	36	24	36	36	36	36	24	36	24

<u>Tank size</u> : maximum negative deviation 150 m^3

Tank should be 160 m^3 + 20% <u>ie 190 m^3</u>

complete fermentation every 2 days = 80 m^3/day, [illegible] = [illegible] 30 m^3/day

Notes

1 vessel empties at 5 m^3/h 16h/day = 80 m^3/24 hours

2 filling Batches 94 m^3
days 2, 4, 6, 9, 11, 13, 15, 18, 20, 22, 24, 27, 29

3. withdrawals
day 1 2 3 4 5 [illegible] 9 10 11 12 13 14
m^3 36 [illegible] 24 [illegible] 36 [illegible] 36 24 36 24

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD. CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page WP 33
		Made by	Rev.
		Checked by	Date

PROJECT

FERMENTATION PLANT + EQUIPMENT SUMMARY DIAGRAM

WP	SECTION	FLOW DIAGRAM No 1.			
	MEDIA PREPN	(1 batch every 2 days see WP 13)			
WP 20/23 26	VESSELS	CAPACITY	BASIS	item	COST $
	CORN STEEP LIQUOR	120 m³	4 days supply	MP1	
	MEDIUM MAKE UP	100 m³	1 batch	MP5	
	WEIGH HOPPER	2 m³		MP4	
	PUMPS				
	CSL	50 m³/h	2 hour fill		
	FEED TO STERILN.	40 "	" " "		
	SOYA	4 "			
	MEDIA STERILIZATION	50 "	" "		SF 150,000
	OTHERS				
	BAG OPENING	50 bags/h	6 hours	MP3	£ 20,000
	DRUM PUMP	10 drums/h			

ADDITIVE PREPARATION — FLOW DIAGRAM Nº 2 (3 fermentations at any one time see WP 25)

WP 20,23	MAKE-UP TANKS (note 4)	m³ (note 4)	STERILIZING TANKS litre (note 6)	flow rate litre/hour (note 5)
	Ammonium sulphate	15	2000 litre	400
note 1	" hydroxide *	"	not reqd	"
" 2	Caustic liquor	12	2000	350
	Sulphuric acid	1.6	carboys?	50
	Soy bean oil	10	2000	300
	Sucrose soln	30	3500	800
	Soy bean : PPG	6	1000	200
3	Precursor	10	1000	250

note 1 use NH_3 gas
2 caustic liquor or potash
3 phenylacetic acid salt
4 basis : 2 days supply – WP 20 (B)
5 " : (maximum flow) x 2 from WP 20 (B)
6 " 8 hours residence time make-up once/shift

FERMENTATION WP 4 FLOW DIAGRAM NO 3

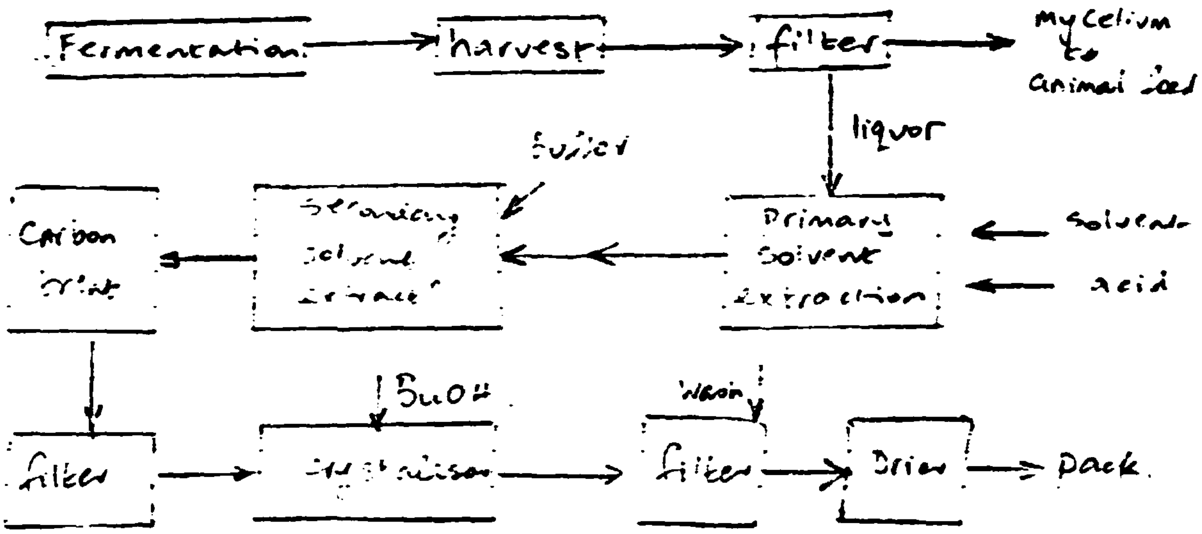
100 m³ capacity	3 off	to 1999	Fermenters	(WP 6)
" "	4 off	from 2000	"	
"		"	Harvest receiver	(WP 28)

MANDERSTAM	**CONSULTING ENGINEERS** 2/10 HARBOUR YARD, CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page [illegible]
		Made by	Rev.
		Checked by	Date

PROJECT

EXTRACTION

Process. (No others available)

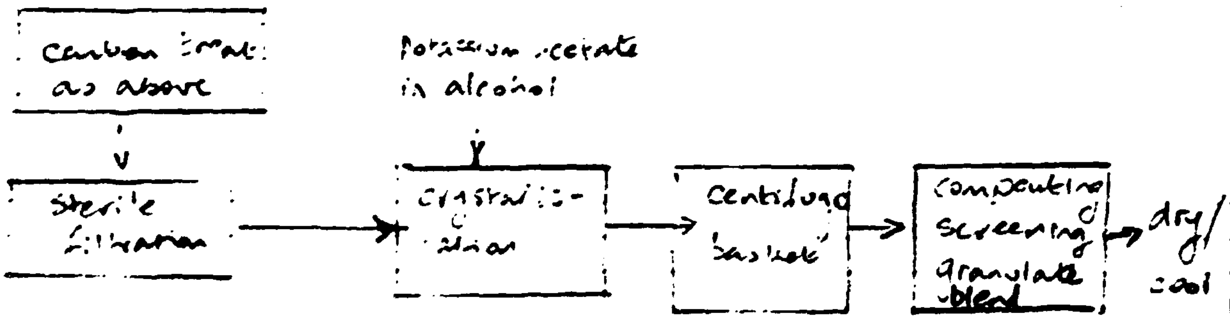


Notes!

1 See WP 23 in description of extraction.

2 Other methods also valid [illegible] primary extraction

3 [illegible] from penicillin [illegible] after carbon treat



MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD CHELSEA HARBOUR LONDON SW10 OXD	Job No.	Page WP 35
		Made by	Rev.
		Checked by	Date

PROJECT

EXTRACTION BULK PENICILLIN

<u>Basis</u> : design capacity 2000-5 4.62 m³/h on 16 hour day 4.62 m³/h = 20 usgpm = 17 igpm

ITEM	DUTY	FLOW
MYCELIUM FILTER ROTARY VACUUM OR EQUIVALENT	1) REMOVE MYCELIUM FROM FERMENTATION BROTH SG 1.07 2) WATER WASH	0.5 m³/h mycelium 4.12 m³/h broth 250 lit/h

(Stockdale rotary vacuum Macclesfield or equivalent)

2-STAGE LIQUID-EXTRACTOR 95%	1) ACIDIFY BROTH 2) EXTRACT PEN G INTO BUTYL ACETATE * SOLVENT (SG 0.88)	sulphuric acid 1.2 m³/h

(Alfa Laval Model [illegible] rated [illegible]
Podbielniak B10 " 4.77 m³/h)

(* other solvents also [illegible], MIBK, [illegible], $CH_3COOC_5H_{11}$ etc)

CHARCOAL TREATMENT	1) REMOVE IMPURITY (use [illegible] active clay, charcoal)	CARBON Solvent pen 'X'	5 kg 1.2 m³/h 80 kg/h

('X' see WP <u>18</u> 1.73% w/v. Basis 1 batch/h 16 h/day)

CHARCOAL FILTER	REMOVE CHARCOAL EARTH, IMPURITY	5 kg / batch. 5 " " ?

(Nijgava Type [illegible] Alkmaar, Holland or equivalent)

MANDERSTAM	**CONSULTING ENGINEERS** 2/10 HARBOUR YARD. CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page WP 36
		Made by	Rev.
		Checked by	Date

PROJECT

ITEM	DUTY	FLOW
CRYSTALISER (AGITATED VESSEL) OR EQUIVALENT	CRYSTALISE PEN G FROM SOLUTION OF BUTYL ACETATE	$5m^3/h$ solution 80 kg/h penicillin
CRYSTAL FILTER (ROTARY VACUUM) OR EQUIVALENT	REMOVE PEN G CRYSTALS SOLVENT TO RECOVERY	80 kg/h PEN
CRYSTAL DRYER ROTARY, TUMBLER FLUID BED OR EQUIV	REMOVE SOLVENT	80 kg/h PEN

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD. CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page WP 37
		Made by	Rev.
		Checked by	Date

PROJECT

DOWNSTREAM RECOVERY EQUIPMENT LIST DIAG No 4

DR			BASIS
1	HARVEST VESSEL	90 m^3	WP 32
2	" DISCH PUMP	6 m^3/h	WP 29 (b) 2 shift working
4	FILTER PRETREAT	5 m^3	note (a)
5	ROTARY VAC FILTER	15 m^2	Makers recommendation
6	FILTERED BROTH SEPARATOR	2 m^3	–
7	" " RECEIVER	30 m^3	6 hours stock buffer
8	CENTRIFUGAL EXTRACTOR		1 stage 95% effy.
9	EXTRACTOR FEED PUMP	6 m^3/h	
10	FILTERED BROTH COOLER	20 m^2	estimate only
11	ADDITIVE VESSEL	500 litres	
12	METERING PUMP	10 - 100 lit/hour	
13	SPENT BROTH SURGE V	1 m^3	
14	ACID MAKE UP VESSEL	4 m^3	(note 2) 8 hours
15	ACID METERING PUMP	300-700 kg/h	" " " "
16	DILUTE CAUSTIC VESSEL	4 m^3	est
17	butyl acetate FEED V	"	2 hours
18	butyl acetate feed pump	5 m^3/h	theoretical 2 m^3/h

Notes

1. Precoat estimate volume 15.1 m^2 surface 25 mm thick

= 0.3775 m^3 precoat assume 20% slurry
1.51 water

1.8875 m^3 total ∴ use 5 m^3 tank.

2. Sulphuric acid quantity

	H_2SO_4 +		2 Pen COONa → 2 Pen COOH + Na_2SO_4
m.w	98		378.1
moles	1	Δ	2
kg/h	49	as 100%	96
kg mol/h	0.5		0.25

3 Alkali usage using, say, $KHCO_3$, MW 100

	Pen COOH +	$KHCO_3$ → Pen COOK + H_2CO_3 carbonic acid
MW	356	100
kg/h	96	27
	1	0.28

* 5 m^3/h broth 1.6% = 96 kg Pen 5/h, 0.25 kg mol/h Δ 500 kg/h as 10% soln

DOWN STREAM RECOVERY (DR) Diagram 4

UNIDO - Philippines Penicillin G Equipment List

ITEM REF	Description of item.	Capacity or size	Mat of constⁿ	No, off	Quoted yes	Quoted no	$ price
DR 1	Harvest vessel	200 m^3	316	1.	✓		132,000
DR 2	Harvest vessel agitator	40 kW	316	1	✓		76,500.
DR 3	Harvest vessel discharge pump	6 m^3/hr	316	1			
DR 4	[illegible] vessels	10 m^3	316	2			
DR 5	Rotary Vacuum Filter	15 m^2	316	1	✓		102,000
DR 6	Filtered Broth [illegible]	1 m^3	316	1			
DR 7	Filtered Broth Receiver	25 m^3	316	1			
DR 8	Primary Extractor B-10	6 m^3/hr	316	1	✓		149,768
DR 9	Primary Extractor feed pump (centrif 2 barg)	6 m^3/h	316	1		✓	
DR 10	Filtered Broth Cooler	20 m^2	316	1		✓	
DR 11	De-emulsifier vessel	500 lit	"	1			
DR 12	de-emulsifier metering pump	10-100 lit/hr	"	1			
DR 13	Spent broth storage vessel	1 m^3	"				
DR 14	Sulphuric acid make-up vessel	4 m^3	PE				
DR 15	Sulphuric acid metering feed pump	10-100 lit/h	PE				
DR 16	dilute Caustic vessel	4 m^3	CS				
DR 17	Butyl acetate feed vessel	4 m^3	316				
DR 18	Butyl acetate feed pump	3 m^3/h	316				
DR 19							

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD CHELSEA HARBOR LONDON SW10 OXD	Job No.	Page WF 39
		Made by RLJ	Rev.
		Checked by	Date 9.9.91.

PROJECT PHILIPPINE ANTIBIOTICS

FILTRATION EQUIPMENT. PENICILLIN RECOVERY

(Position Number 211 1 off required)
A) MYCELIUM FILTER ROTARY VACUUM OR EQUIVALENT

Duty: To remove mycelium from fermenter broth discharged from fermenters.

Broth temperature 25°C
flow 5 m^3/h 16 h per day
sg 1.07

Mycelium 0.5 m^3/h

Wash water

(Position Number 212 1 off required)
B) CHARCOAL REMOVAL FILTER PRESSURE TYPE OR EQUIVALENT

Duty: To remove carbon, active earth and impurity from solution of Penicillin G in butyl acetate.

flow rate 1.2 m^3/h 16 h/day
sg solvent 0.88
charcoal 5-10 kg

basis: 1.2 m^3 batch per hour batch or
1.2 m^3/h continuous.

(Position Number 213 1 off Required)
C) PENICILLIN FILTER - ROTARY VACUUM/PRESSURE

Duty: Removal 80 kg/h penicillin G crystalls from butyl acetate solvent. Solvent wash. Basis batch or continuous

---

Materials of construction: 316 stainless steel, ptfe

Power 380v 60Hz 3 phase
Zone filter A safe.
" " B and C Zone 1

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD CHELSEA HARBOUR LONDON SW10 OXD	Job No.	Page WP 40
		Made by RLJ	Rev.
		Checked by	Date 9.9.91.

PROJECT PHILIPPINE ANTIBIOTIC FLS

CENTRIFUGAL LIQUID - LIQUID EXTRACTOR

POSITION NUMBER 214, 215 No REQUIRED 2 (or 1)

Duty: To extract penicillin G from fermented filtered broth, $4.2 m^3/h$, 25°c, 16 hours/day using n butyl acetate $1.2 m^3/h$. Broth acidified to pH 2.0 using sulphuric acid. Two machines required at 2 theoretical stages. for 98% recovery

Specific gravity broth 1.07.
solvent 0.88

Power 318 volts 50 Hz 3 phase

Materials of construction 316 stainless.

Recovery: 95% one machine
98% two machines in series..

BUFFER SOLUTION EXTRACTOR.

Duty: to recover penicillin into buffer solution aqueous phase.

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD, CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page WP 41
		Made by	Rev.
		Checked by	Date

PROJECT

EQUIPMENT LIST PENICILLIN PURIFICATION DIAGRAM 5

PP N°	ITEM	Size	No off	basis	note
1	SPENT BuOAc VESSEL	$6 m^3$	1	~~4~~ hours	1
2	RICH BuOAc VESSEL carbon treat	$3 m^3$	2	1½ " RT	2
3	Buffer make-up	$40 m^3$	1	8 hours	3
4	BuOAc + buffer surge	$12 m^3$	1	2 hours	
5	" " " feed pump	$6 m^3/h$	1	"	
6	Secondary extractor	$6 m^3/h$			
7	rich ~~[illegible]~~ surge vessel	$4 m^3$	1	2 hours	
8	" dilution "	$8 m^3$	1	"	
~~8~~ 9	Butanol	$4 m^3$	1	"	
10	crystallizer	$8 m^3$	1	"	
11	slurry vessel	$8 m^3$	1	"	
12	filter	$1.75 m^2$	1	makers rec	
13	dryer	—	1	RLJ	
14	charcoal filter	$25 m^2$	1	makers rec	
15	Buffer soln feed pump	$6 m^3/h$	1	"	

notes

1. output BuOAc 3:1 Solvent ratio basis 16 hours per week (see WP 14)

m^3 BuOAc/hour year per 16 hour day

1.37/3 = .45 m^3/h 1995

1.45 m^3/h 2010 23.2 m^3

2. Carbon 0.3% w/v. Basis 2010 (WP 15)
1 batch 1 hour residence time $3 m^3$ vol tank
carbon usage
a) 125 Bou 75 kg 5-10 kg charcoal reqd./h.
or 100 kg / hour

3 Buffer make up volume × 3 solvent (see WP 44)

required 1.45 × 3 = m^3/h say $5 m^3/h$ aqueous

Basis 8 hours 5 × 8 = $40 m^3$ make-up tank

4 Penicillin per hour WP 14 75 kg pen/hour max
flow per hour

PENICILLIN PURIFICATION (PF) FLOW DIAGRAMS REFERS

UNIDO - Philippines

Penicillin G

Equipment List

ITEM REF	Description of item.	Capacity or size	Mat of const^n	No. off	Quoted yes	Quoted no	$ price
PP1	Spent butyl acetate vessel	$6m^3$	316	1			
PP2	Rich butyl acetate vessel carbon treatment	$3m^3$	"	2			
PP3	Buffer make-up vessel	$40m^3$	"	1			
PP4	Butyl acetate and buffer surge vessel	$12m^3$	"	1			
PP5	" " " " feed pump	$6m^3/h$	"	"			
PP6	[illegible] extractor Podbielniak A1	$2m^3/h$	"	"			40,000
PP7	Rich penicillin surge vessel	$4m^3$	"	"			
PP8	Rich penicillin dilution vessel	$8m^3$	"	"			
PP9	Butanol supply vessel	$4m^3$	"	"			
PP10	Penicillin crystallizer	$8m^3$	"	"			
PP11	Penicillin crystallizer slurry vessel	$8m^3$	"	"			
PP12	Penicillin filter.	$1.75m^2$	"	"	✓		102,000
PP13	Penicillin dryer.	–	"	"		✓	85,000
PP14	Rich butyl acetate - carbon filter.	$25m^2$	316	"	✓		35,000
PP15	Buffer solution feed pump						

WP 42

WP 43

APV

PRIMARY & SECONDARY PENICILLIN EXTRACTION

The Podbielniak Contactor, in a compact space, offers high recovery of penicillin from the filtered broth by solvent extraction. The solvent employed is typically amyl or butyl acetate although other solvents such as methyl isobutyl ketone (MIBK) are used. Primary stage recoveries, based on the spent broth, in excess of 95 percent at a typical flow ratio of three to five filtered broth to one solvent are achieved. The combined flow capacity of the Models B-10-P, D-18-P, and D-36-P in processing antibiotic extractions, is approximately 6, 15, and 30 cubic meters per hour respectively.

Positive displacement turbine type pumps are used with the B-10-P Pod in the aqueous and solvent feeds due to the head requirements and reltively low flowrates. These pumps are provided with back pressure regulators for over-pressure protection, and recycle to the feed tank of excess capacity.

The filtered broth is pumped and metered to the primary extraction Pod heavy-liquid-in position, where the pressure is approximately 2-4 atmospheres. Treating agents are metered into the filtered broth to reduce the emulsification tendency of the broth. Just prior to the Pod, the filtered broth stream is acidulated to the extraction pH. The pH of the spent broth is measured (less than 30 seconds downstream), and controlled either by directly controlling the acid flowrate or simultaneously by cascade operation of the pH and acid flow controllers. The quality of the heavy-liquid-out is observed in the effluent sightglass.

The fresh solvent is pumped and metered to the primary extraction Pod light-liquid-in position where the pressure is approximately 5-6 atmospheres. The solvent passes counter-current to the broth in the Pod, and exits via the light-liquid-out position, where a sightglass is installed for quality observation. The pressure of the rich solvent effluent is maintained at 2-4 atmospheres via pressure instrumentation and a pressure control valve. The pressure is maintained, as high as possible, consistent with the quality of this Pods heavy effluent. The higher the back pressure, the greater the portion of the Pod counter-current contact zone is heavy liquid dispersed with is desired for extraction efficiency.

The spent broth leaves this primary extraction Pod essentially free of entrained solvent and passes to neutralization and/or distillation for recovery of dissolved solvent. The rich solvent is temporarily collected in a suitable vessel (under level control) prior to the secondary recovery step. In some cases, this rich solvent may undergo a counter-current wash before the next step, whereas in other cases, the rich solvent may undergo decolorizing via carbon adsorption.

W947

Secondary extraction is done at the opposite heavy phase to light phase flow ratios as that practised in primary extraction. The flow ratios of rich solvent (light)-to-fresh buffer (heavy) vary from three to five to one to fifteen to thirty to one. In this case, the extraction efficiency desired high flow dispersed (low flow continuous) is represented by a low light-liquid-out back pressure.

The rich solvent is pumped and metered under level and flow control to the secondary Pod light-liquid-in position where the pressure is approximately 5-6 atmospheres. The solvent passes counter-current to the buffer in the Pod, and exits via the light-liquid-out position, where a sightglass is installed for quality observation. The pressure of the rich solvent effluent is maintained at 2-4 atmospheres via pressure instrumentation and a pressure control valve. The pressure is maintained, as low as possible, consistent with the quality of this Pods light effluent. The lower the back pressure, the greater the portion of the Pod counter-current contact zone is light liquid dispersed which is desired for extraction efficiency. The spent solvent is forwarded to solvent purification or in some cases recycled directly to the primary extraction.

The fresh buffer is pumped and metered to the secondary extraction Pod heavy-liquid-in position, where the pressure is approximately 2-4 atmospheres. The pH of the rich buffer effluent is measured, and controlled at the desired extraction pH either by directly controlling the fresh buffer flowrate or simultaneously by cascade operation of the pH and buffer flow controllers. The quality of this heavy-liquid-out is observed in the effluent sightglass.

The rich buffer passes to further processing and finally crystallization of the penicillin product.

WP 45

ACCESSORY EQUIPMENT LIST: Primary & Secondary Antibiotic Extraction, APV Chemical Machinery Drawing No. 2017-055.

FEED PUMPS

P-1	Filtered Broth Feed Pump
P-2	Fresh Solvent Feed Pump
P-5	Rich Solvent Feed Pump
P-6	Fresh Buffer Feed Pump
P-3	Reagent Feed Pump
P-4	Treating Agent Feed Pump

CONTROL VALVES

FCV-1	Filtered Broth Flow Control Valve
FCV-2	Fresh Solvent Flow Control Valve
FCV-5	Rich Solvent Flow Control Valve
FCV-6	Fresh Buffer Flow Control Valve
PCV-1	Pod X-1 LLO Pressure Control Valve
PCV-2	Pod X-2 LLO Pressure Control Valve
BPR-2	Fresh Solvent Pump Back Pressure Regulator
BPR-5	Rich Solvent Pump Back Pressure Regulator
BPR-6	Fresh Buffer Pump Back Pressure Regulator

INSTRUMENTATION - FIELD

FIT-1	Filtered Broth Flow Indicating Transmitter
FIT-2	Fresh Solvent Flow Indicating Transmitter
FIT-3	Reagent Flow Indicating Transmitter
FIT-5	Rich Solvent Flow Indicating Transmitter
FIT-6	Fresh Buffer Flow Indicating Transmitter
FI-4	Treating Agent Flow Indicator
SFI-1L	Pod X-1 Light Liquid Effluent Sight Flow Indicator
SFI-1H	Pod X-1 Heavy Liquid Effluent Sight Flow Indicator
SFI-2L	Pod X-2 Light Liquid Effluent Sight Flow Indicator
SFI-2H	Pod X-2 Heavy Liquid Effluent Sight Flow Indicator
PI-P	Feed Pumps - Pressure Indicators (6)
PI-X1/X2	Pods X-1/X-2 - Pressure Indicators (8)
PIT-1	Pod X-1 LLO Pressure Indicating Transmitter
PIT-2	Pod X-2 LLO Pressure Indicating Transmitter
LIT-1	Vessel V-1 Level Indicating Transmitter
PHIT-1	Spent Broth pH Indicating Transmitter
PHIT-2	Rich Buffer pH Indicating Transmitter

W? 36

INSTRUMENTATION - PANEL

ICP-1	Instrument Control Panel
FIC-1	Filtered Broth Flow Indicating Controller
FIC-2	Fresh Solvent Flow Indicating Controller
PIC-1	Pod X-1 LLO Pressure Indicating Controller
PIC-2	Pod X-2 LLO Pressure Indicating Controller
LIC-1	Vessel V-1 Level Indicating Controller
PHIC-1	Spent Broth pH Indicating Controller
PHIC-2	Rich Buffer pH Indicating Controller
FIC-3	Reagent Flow Indicating Controller
FIC-5	Rich Solvent Flow Indicating Controller
FIC-6	Fresh Buffer Flow Indicating Controller
R-1	Recorder (4 Pen)

ELECTRICAL

MS-P1	Filtered Broth Pump Motor Starter
MS-P2	Fresh Solvent Pump Motor Starter
MS-P3	Reagent Pump Motor Starter
MS-P4	Treating Agent Pump Motor Starter
MS-P5	Rich Solvent Pump Motor Starter
MS-P6	Fresh Buffer Pump Motor Starter
RMS-X1	Pod X-1 Reversible Motor Starter
RMS-X2	Pod X-2 Reversible Motor Starter
PBS-P1	Filtered Broth Pump Push Button Station
PBS-P2	Fresh Solvent Pump Push Button Station
PBS-P3	Reagent Pump Push Button Station
PBS-P4	Treating Agent Pump Motor Starter
PBS-P5	Rich Solvent Pump Push Button Station
PBS-P6	Fresh Buffer Pump Push Button Station
RPBS-X1	Pod X-1 Reversible Push Button Station
RPBS-X2	Pod X-2 Reversible Push Button Station

OTHER

MT/CV-1	Pod X-1 Mixing Tee

WP 17

ACCESSORY EQUIPMENT: Primary & Secondary Antibiotic Extraction, APV Chemical Machinery Drawing No. 2017-055.

FEED PUMPS

Centrifugal Type: Type 316 stainless steel construction, complete with mechanical seal and including baseplate, coupling guard, and explosion-proof drive motor.

P-1	Filtered Broth Feed Pump

Regenerative Turbine Type: Type 316 stainless steel construction, complete with mechanical seal and including baseplate, coupling guard, and explosion-proof drive motor.

P-2	Fresh Solvent Feed Pump
P-5	Rich Solvent Feed Pump
P-6	Fresh Buffer Feed Pump

Piston Type: Type Alloy 20 stainless steel construction, piston type metering pump including baseplate, coupling-guard, and explosion-proof drive motor. With pneumatic control valve for infinite adjustment of output. Complete with a pulsation dampening chamber.

P-3	Reagent Feed Pump

Piston Type: Type 316 stainless steel construction, piston type metering pump including baseplate, coupling guard, and explosion-proof drive motor. Complete with a pulsation dampening chamber.

P-4	Treating Agent Feed Pump

CONTROL VALVES

Pneumatic Control Valves: Flangeless (clamped between 150-600 lbs. ANSI line flanges), globe single seat with wide rangeability. Body material of Type 316 stainless steel with Teflon/asbestos bonnet packing. Spring and diaphragm type actuator and handwheel for manual operation.

CONTROL VALVES (continued)

FCV-1	Filtered Broth Flow Control Valve
FCV-2	Fresh Solvent Flow Control Valve
FCV-5	Rich Solvent Flow Control Valve
FCV-6	Fresh Buffer Flow Control Valve
PCV-1	Pod X-1 LLO Pressure Control Valve
PCV-2	Pod X-2 LLO Pressure Control Valve

Back Pressure Regulator: Continuously operating, manually adjusted (handwheel), spring and diaphragm operated, with Teflon O-rings. Pressure relief valve on pump recycle. Type 316 stainless steel wetted parts and threaded connections.

BPR-2	Fresh Solvent Pump Back Pressure Regulator
BPR-5	Rich Solvent Pump Back Pressure Regulator
BPR-6	Fresh Buffer Pump Back Pressure Regulator

INSTRUMENTATION - FIELD

Flow Indicating Transmitters: Armored Indicating Flow Transmitter of variable area design and wide rangeability. Type 316 stainless steel fittings, metering tube, and float with flanged connections. Complete with a case installed Pneumatic Transmitter providing a signal linearly proportional to the flow and a direct reading segmental scale indicator. Reagent meter has Hastelloy C wetted parts.

FIT-1	Filtered Broth Flow Indicating Transmitter
FIT-2	Fresh Solvent Flow Indicating Transmitter
FIT-3	Reagent Flow Indicating Transmitter
FIT-5	Rich Solvent Flow Indicating Transmitter
FIT-6	Fresh Buffer Flow Indicating Transmitter

Flow Indicators: Glass tube flowrator, variable area meter with wide rangeability. Type 316 stainless steel fittings and float with teflon packing and screwed connections.

FI-4	Treating Agent Flow Indicator

Sight Flow Indicators: For vertical upward or horizontal flow, with flapper-type indicator for visual verification of flow. Type 316 stainless steel body, wetted teflon gaskets, pyrex windows, and flanged connections.

SFI-1L	Pod X-1 Light Liquid Effluent Sight Flow Indicator
SFI-1H	Pod X-1 Heavy Liquid Effluent Sight Flow Indicator
SFI-2L	Pod X-2 Light Liquid Effluent Sight Flow Indicator
SFI-2H	Pod X-2 Heavy Liquid Effluent Sight Flow Indicator

WP 45

INSTRUMENTATION - FIELD (continued)

Pressure Indicators: Bourdon tube and threaded socket (316 SS) design. Direct reading, local indication only. Not illustrated.

PI-P	Feed Pumps - Pressure Indicators (6)
PI-X1/X2	Pods X-1/X-2 - Pressure Indicators (8)

Pressure Indicating Transmitter: Small case pressure indicating transmitter with Type 316 stainless steel element to be directly coupled to the process line. Complete with a case installed Pneumatic Transmitter providing a signal linearly proportional to the pressure.

PIT-1	Pod X-1 LLO Pressure Indicating Transmitter
PIT-2	Pod X-2 LLO Pressure Indicating Transmitter

Level Indicating Transmitter: Displacer-type liquid level transmitter of Type 316 stainless steel construction. Complete with pneumatic transmitter providing a 0.2-1.0 kg/cm^2 output signal linearly proportional to the liquid level. Vessel V-1 is not supplied.

LIT-1	Vessel V-1 Level Indicating Transmitter

pH Indicating Transmitter: Flow through electrode chamber, pH-to-current indicating monitor, and current-to-air converter.

PHIT-1	Spent Broth pH Indicating Transmitter
PHIT-2	Rich Buffer pH Indicating Transmitter

pH Sensor: Flow through electrode chamber of Type 316 stainless steel construction for installation on a process stream bypass. The pH sensor assembly is of hard plastic (Ryton) construction with intregral (permanent) temperature compensator, and spherical glass plug-in type measuring electrode, and ceramic non-flowing reference electrode. Including 20 feet (6 meters) of integral multi-conductor shielded cable.

pH-to-Current Monitor: All solid-state for field installation with digital display reading 0 to 14 pH. NEMA type 4X enclosure providing environmental protection. Converts the dc millivolt signal to a 4 to 20 mA dc output signal when supplied with 220 volt, 50 Hertz electrical power.

Current-to-Air Converter: Weather and explosion-proof enclosure for field installation with NEMA 7, Class I, Groups C and D, Division I electrical classification. Converts the 4 to 20 mA dc input signal into a 0.2-1.0 kg/cm^2 output signal.

WP 50

INSTRUMENTATION - PANEL

Panel: Self-standing panel, finished in green textured polyurethane, of sheet metal construction. The panel will contain the indicating controllers, recorder, and necessary internal pneumatic piping and wiring connected to the convenient exterior bulk head fittings including the Master Impulse Unit for pneumatic chart drive with electric explosion-proof motor (220 volt, 50 Hertz, single phase) of Class I, Groups C and D, Division I electrical classification. Complete with dual filter/regulator and pressure gauge set.

Indicating Controllers: Panel mounted of miniature design and pullout chassis for convenient maintenance. Manually positioned set point with wide proportional bank and fast automatic reset and direct reading scale.

FIC-1	Filtered Broth Flow Indicating Controller
FIC-2	Fresh Solvent Flow Indicating Controller
PIC-1	Pod X-1 LLO Pressure Indicating Controller
PIC-2	Pod X-2 LLO Pressure Indicating Controller
LIC-1	Vessel V-1 Level Indicating Controller

Indicating Controller: As above, but including derivative in addition to proportional and reset.

PHIC-1	Spent Broth pH Indicating Controller
PHIC-2	Rich Buffer pH Indicating Controller

Indicating Controller: Panel mounted of miniature design and pull-out chassis for convenient maintenance. Manually and pneumatically positioned set point with remote/local switch. With wide proportional band and fast automatic reset and direct reading scale.

FIC-3	Reagent Flow Indicating Controller
FIC-5	Rich Solvent Flow Indicating Controller
FIC-6	Fresh Buffer Flow Indicating Controller

Recorder: Panel mounted of miniature design and pull-out chassis for convenient maintenance. Pneumatically piped to each of the controllers for simultaneous recording of four (4) selected variables. Chart driven via pneumatic pulsed motor.

R-1	Recorder (4 Pen)

WP 51

ELECTRICAL

Motor Starters: Magnetic type with combination circuit breaker in a light weight aluminum, bolted-cover enclosure of NEMA Type 7 for hazardous location and Class I, Groups C and D electrical classification. Power to be 3 phase, 380 volt, 50 Hertz. With thermal type (3 pole) overload relays (reset from outside the enclosure) to provide motor protection; and magnetic circuit breaker, with lockable external operating handle, for short circuit protection. Including installed control circuit transformer, with secondary for 110 volts. Pod starters are reversible.

MS-P1	Filtered Broth Pump Motor Starter
MS-P2	Fresh Solvent Pump Motor Starter
MS-P3	Reagent Pump Motor Starter
MS-P4	Treating Agent Pump Motor Starter
MS-P5	Rich Solvent Pump Motor Starter
MS-P6	Fresh Buffer Pump Motor Starter
RMS-X1	Pod X-1 Reversible Motor Starter
RMS-X2	Pod X-2 Reversible Motor Starter

Pump Push Button Stations: Heavy-duty, NEMA 7 push button station suitable for Class I, Groups C and D hazardous locations. Located at the pump motor on a 110 volt pilot circuit for operation of the starter. Pump stations are assembled with two push buttons (start/stop) and one pilot light. Pod stations are assembled with three push buttons (forward/reverse/stop) and two pilot lights.

PBS-P1	Filtered Broth Pump Push Button Station
PBS-P2	Fresh Solvent Pump Push Button Station
PBS-P3	Reagent Pump Push Button Station
PBS-P4	Treating Agent Pump Motor Starter
PBS-P5	Rich Solvent Pump Push Button Station
PBS-P6	Fresh Buffer Pump Push Button Station
RPBS-X1	Pod X-1 Reversible Push Button Station
RPBS-X2	Pod X-2 Reversible Push Button Station

OTHER

Mixing Tee and Check Valve: Proprietary design (Teflon/Alloy 20) for installation at the Pod flexible connector for reagent addition and mixing.

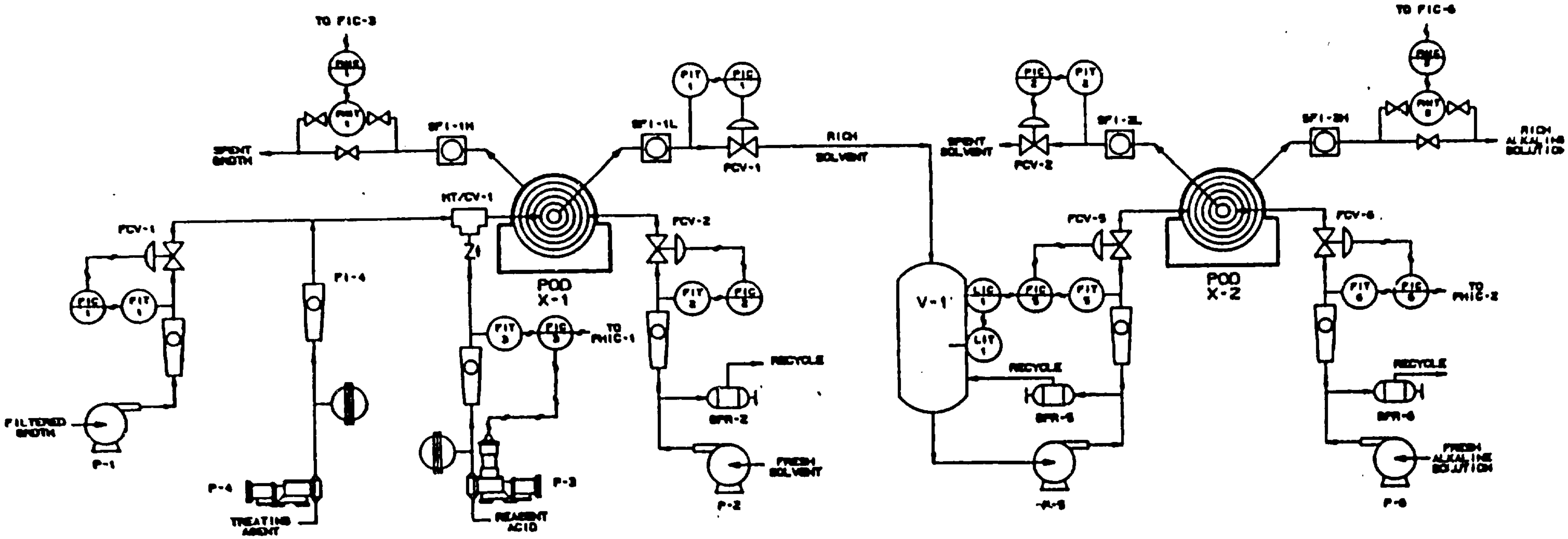
Teflon lined tee of flangeless design to fit between the Pod inlet flange connection and the flanged flexible connector. Solid Teflon sparger for reagent injection and flanged reagent connection to provide thorough mixing and pH adjustment. Complete with non-return valve of Alloy 20 stainless steel construction.

MT/CV-1	Pod X-1 Mixing Tee

2017-055 | B

BAKER PERKINS INC.
SAGINAW MICHIGAN

DRAWN: HAL DATE: 9 SEPT 8



PRIMARY & SECONDARY ANTIBIOTIC EXTRACTION

WPS1A

EXTRACTION — RUNNING EXPENSES — CONSUMPTIONS

INSTALLED POWER		INSTALLED KW	USAGE %	USED KW
[illegible]	[illegible]	[illegible]	100	20
"	PUMP [illegible] 2bar	40	100	40
[illegible]	[illegible]	10	50	5
FILTER		10	66	6.6
VACUUM PUMP		10	66	6.6
WASTE PUMP		40	66	26
PUMP		40	66	26
EXTRACTOR [illegible]		6	66	3
SOLVENT PUMP		15	66	9
[illegible]		50	66	33
REFRIGERATION		120	50	60
[illegible]		150		235
totals		500		

x 215.5 hours = 50.525 kWh per batch

COST OF POWER 2.22P /kWh

HOURS PER YEAR 16 HOURS / DAY 8160 x 16/24 = 5440.

SUMMARISED IN WP 18 B

RAW MATERIAL COSTS

	[illegible]	$ TON	DUTY	$ DELIVERED
ACTIVE CARBON	$ ·35/[illegible]	784	10%	996
BICARBONATE POT	0·[illegible]	694	"	881
FILTER AID		49	"	62
BUTYL ACETATE	$ 0·5/[illegible]	1120	10%	1423
[illegible] "	[illegible]	1480	"	1880
BUTANOL	[illegible]	918	"	1166
SALT			0	

FOR QUANTITIES SEE WP 53

WATER per batch [illegible] 215.5 hours
make-up buffer, acid formalin 20
wash down 50
total 70 m^3

STEAM 1 ton /bx.

FACTORS PRESSURE 3 BAR

				WHP	Motor HP	Motor kW
PUMP	FLOW	[illegible] /min	[illegible]	6	8·88	6·63
		[illegible]	[illegible]	60	88	66.63
		[illegible]	[illegible]	[illegible]	[illegible]	666.68

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD. CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page WP 53
		Made by	Rev. 1
		Checked by	Date

PROJECT EXTRACTION RAW MATERIALS SUMMARISED WP 20.

ACTUAL CONSUMPTION BASED ON WP 19, WP 4

CHART 3) RAW MATERIAL CONSUMPTION EXTRACTION/RECOVERY

TONNES PER YEAR

TONNE BASIS/	SOLVENT 11.065 ton per batch (1)	CARBON 0.3% solvent (2)	ALKALI .809 ton batch (3)	BUTANOL 2.39 ton per batch (4)	WP 19 No BATCHES
1995	564	1.7	41	122	51
96	896	2.7	65.5	194	81
97	1117	3.3	81.7	241	101
98	"	"	"		"
99	"			"	"
2000	1272	3.8	93	275	115
01	1317	3.9	96.3	284	119
02	"	"	"	"	"
	"			"	"
4				"	"
05	1460	4.4	107	315	132
06-10	1494	4.5	109	322	135
cost tonne $ delivered	1500	996	881	1166	–

Broth total harvest $166 m^3$/batch Solvent $= 166/3 = 55.3 m^3$
assume 90% recovery. losses $= 5.53 m^3$/batch
80% 11.06 " "

---

(1) 3:1 BROTH : Solvent Amyl + butyl acetate WP 19 SPF
(2) 0.3% solvent
(3) 0.23 ton / ton [illegible] WP [illegible]
(4) 5 [illegible] / 100 loss [illegible]
(5) 40 kg / 0.1% per batch negligible

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD, CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page WP 54
		Made by	Rev.
		Checked by	Date

PROJECT 6-APA PRODUCTION

DESIGN OUTPUT = PRODUCTION × 1·2. 200 ton/year

PRODUCTION c/o WP 4 CHP 3 year 2010 :–

			as Pen	as 6APA		
[illegible]	as [illegible]	Semi Synthetics	total			
A	37·8	[illegible]	237	160·4	×1·2 =	192·5
B	249·8	69·2	319	172		206·4
C	297	–	297	160		192

∴ use 200 ton/year plant design

PRODUCTION [illegible] enzyme process. WP 55

Step 1 E coli fermentation
2 Preparation of amidase enzyme resin
3 Enzymatic [illegible] of Pen G
4 Recovery and purification of 6APA

DESIGN BASIS 200 tonnes/year 6 APA. WP 56

Required – 330 × 600 kg 6-APA batches

– [illegible] enzyme resin

– 15 E. coli 30 m^3 fermentations

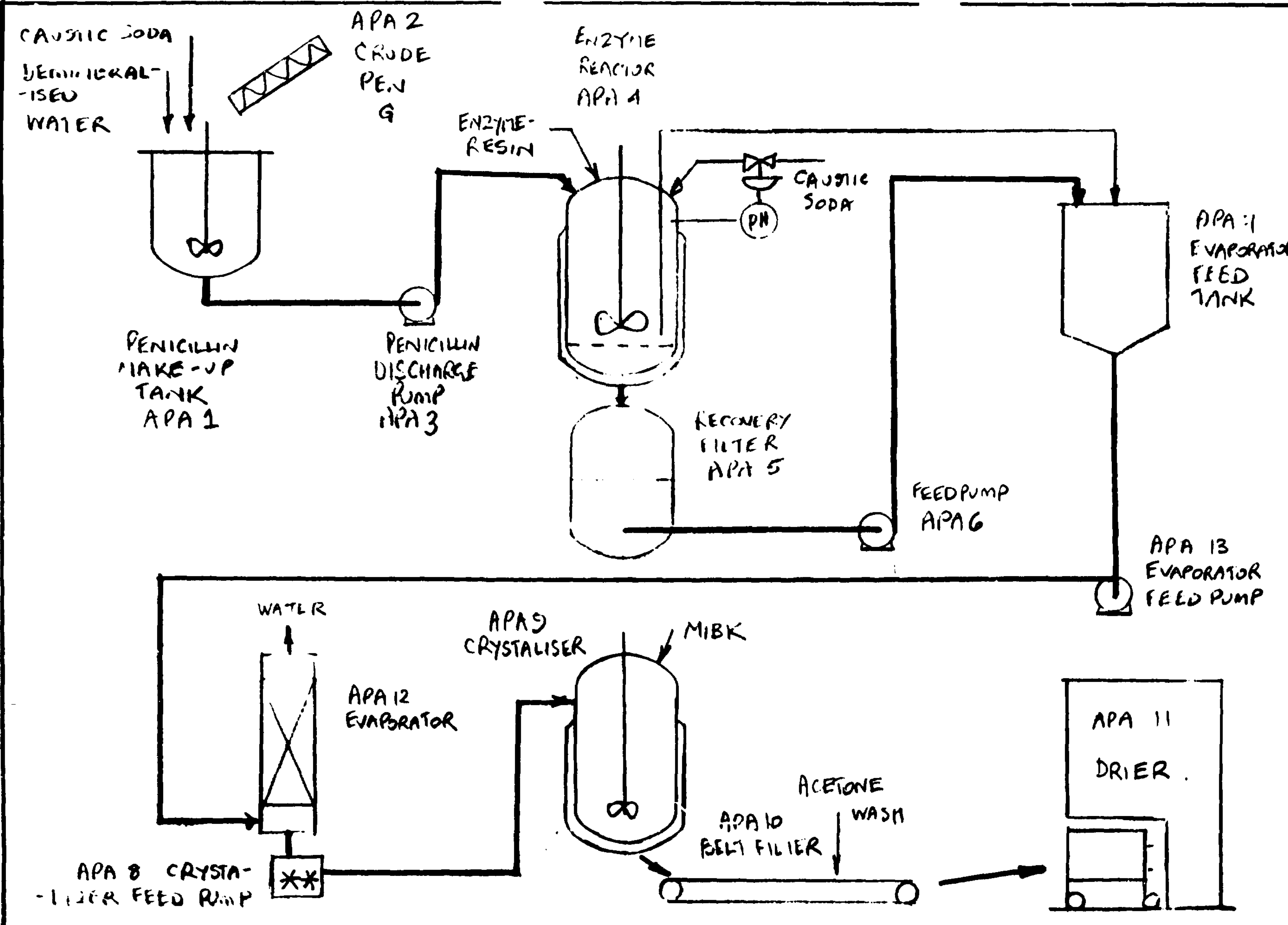
RAW MATERIALS see WP 56

UTILITIES costs see WP 12B amounts :–

		Per 600kg Batch	per tonne 6APA pesos
Power	50 kW × 24 × 2·22	2664 Pesos	P 4440
Water	2 ton × 3·17	6	P 10
Steam	1 ton × 600	600	P 1000

Total per tonne 6-APA $\boxed{5450 \text{ pesos}}$

assume smaller capacity double above ie 100 kW
[illegible] water [illegible] steam



PROJECT

6-APA PRODUCTION FLOW SCHEME

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD, CHELSEA HARBOUR LONDON SW10 OXD	Job No.	Page WP 56
		Made by	Rev. 1
		Checked by	Date

PROJECT 6-APA PRODUCTION - OUTPUT - RAW MATS & UTILITIES

PRODUCTION 6APA	REF TYP	'35	'36	'37/9	2000	'01/4	'05	2006-10
		6APA O/P		OPTION A				
6-DA FS RNG	+	121	[illegible]	232	248	256	290	298
AS (x c APP.	-	65	102	[illegible]25	134	138	156	161
90 x 1 (DESIGN FACTOR)		78	122	150	161	166	188.	193

CONSUMPTION OF RAW MATERIALS TONNES/YEAR

								* $/TONNE
PEN G (% 0.54)	121	189	232	248	256	290	298	-
AMIDASE (x ·005)	0·325	·51	·625	0·67	0·69	0·78	0·805	
DICHLORO METHANE (x 6)	[illegible]	[illegible]	750	804	828	336	366	905
[illegible] (x 1·5)	[illegible]	[illegible]	[illegible]	201	207	234	241	130
[illegible] 30% (x 2)	[illegible]	[illegible]	[illegible]	267	276	312	322	90
ACETONE (x [illegible])	162	255	[illegible]	335	345	[illegible]	402	1200

(* DELIVERED [illegible] AREA)

UTILITIES COST PESOS x10⁶/YEAR WP 54

0·35 ·56 0·68 0·73 0·75 ·85 ·877 WP 18B

LABOUR Basis 1 batch every day 2 shifts

Production Manager	1	same	as	for penicillin	
Shift managers	2	"	"	"	"
Supervisors	2	extra	to	penicillin	
technicians	4	"	"	"	
Workers skilled	4	"	"	"	
unskilled	4	"	"	"	

PRICE CHECKS

	FOB NY c/lb	FOB NY $/tonne	Delivered Manila site
acetone	40	896	1200
dichloromethane	30	672	905
MIBK	50	1120	1560

$ = 1·331

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD. CHELSEA HARBOUR LONDON SW10 OXD	Job No.	Page WP 57
		Made by	Rev.
		Checked by	Date

PROJECT

EQUIPMENT LIST 6-APA. (APA 1) - WP 56

		CAPACITY	BASIS
APA 1	PEN G MAKE-UP TANK/AGITATOR	$8m^3$	RLJ
2	" " SCREW FEEDER	6" ϕ	$2.4m^3$/hour 1hour to fill
3	" " DISCHARGE PUMP	$20m^3/h$	24mins to MT
4	ENZYME REACTOR	$12m^3$	8hour RT Pent Enz volume
5	ENZYME-RESIN RECOVERY FILTER	500 litres	Resin-enzyme
6	FILTER FEED PUMP	$6m^3$/hr	
7	EVAPORATOR FEED TANK	$12m^3$	Reactor capacity
8	Crystalizer FEED PUMP	$2m^3/h$	3 shift basis
9	6-APA CRYSTALISER	$3m^3$	RLJ
10	BELT FILTER - WASHER	$5m^2$	RLJ
11	FLUID BED DRIER	$1.2m^2$	2 batches/day
12	EVAPORATOR	$2m^3/h$	3 Shift operat!
13	" Feed Pump	$3m^3/h$	
16	[illegible]	[illegible]	

UNIDO - Philippines 6-APA Plan. (Penicillin G PROJECT) Equipment List

ITEM REF	Description of item.	Capacity or size	Mat of constn	No. off	Quoted yes	Quoted no	$ US price
APA 1	Pen G make-up tank /agitator	$8m^3$	316	1		✓	
APA 2	Pen G feed screw	150mm	316	1			6000
APA 3	Pen G discharge pump. Centrifugal 2 stage	$20m^3/h$	316	1			
AP 4	Enzyme Reactor / agitator / jacketed	$12m^3$	316	1			
APA 5	Enzyme recovery filter	litres 500	316	1			
APA 6	Filter feed pump centrifugal 2 stage	$6m^3/h$	316	1			
APA 7	Evaporator feed tank	$12m^3$	316	1			
APA 8	Crystaliser feed pump. Gear pump	$2m^3/h$	316	1			
APA 9	6-APA Crystaller	$3m^3$	316	2			
APA 10	Belt filter/washer	$5m^2$	316	1			
APA 11	Batch fluid bed drier AW 20 Model Exp	500 litre	316	1			90,000
APA 12	Evaporator	$2m^3/h$	316	1			
APA 13	Evaporator Feed Pump	$3m^3/h$	316	1			
APA 14	Fermenter agitator 75 KW	$40m^3$	316	1			
APA 15	Feed tanks	$3m^3$	"	3			
APA 16	Decanter 2	$2m^3/h$	"	1			
APA 17	Vacuum filter	pilot	"	1			40,000
APA 18	Reverse Osmosis Concentrator	"		1			
APA 19	Resin [illegible] tank jacketed/agitated	$1m^3$	"	1			

WP 58

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD. CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page WP 53
		Made by	Rev.
		Checked by	Date

PROJECT BULK SEMI SYNTHETIC PRODN

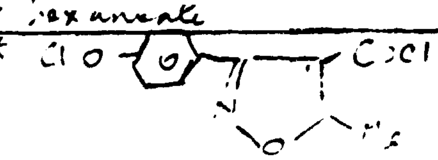
	AMPICILLIN		AMOXYCILLIN		CLOXACILLIN	
	AS PEN	AS AMP	AS PEN	AS AMOXY	AS PEN	AS CLOX
1995	6.2	4.8	13.6	10.6	1.1	0.9
96	7.5	6.6	21.4	16.8	2.1	1.0
7	10.7	8.3	30.2	24.3	3.2	3.0
8	12.3	9.9	38.6	30.3	4.3	4.0
9	13	10	45.3	35.6	5.4	5.1
2000	13	10	45.6	35.8	"	"
1	13	10	51.8	40.6	"	"
2	13	10	53.2	42.3	6.4	6.1
3	12	9.3	56.2	44.1	6.5	6.2
4	11.8	9.1	59.4	46.6	"	"
5	10.8	8.3	61.5	48.3	7.6	7.2
6	"	"	64.2	50.3	8.6	8.2
7	10.7	8.3	68	53.4	8.7	8.3
8	"	"	70.2	55.1	9.7	9.2
9	7.7	6.7	74.6	58.5	11.8	11.2
2010	"	"	78.2	61.8	"	"

REF WP 4 SHEET 3 OF 3.

DESIGN [illegible]

AMPICILLIN	10 × 1.2 =	12.0	tonnes/year
AMOXYCILLIN	62 × 1.2 =	75	" "
CLOXACILLIN	11.2 × 1.2 =	13.5	"

	DUTY %	US $/tonne FOB NY		DELIVERED MANILA
Ethylacetoacetate	10	2350		3270
MeOH USP		3500		4870
EtOH		850		1182
Me_2CO		1000		1400
CH_2Cl_2		650		905
MIBK		1120		1560
Et_3N		2800		3895
D C_6H_4 glycine USP		18400		25600
Δ Ethyl chloro carbonate		12500	TBC	17394
NH_4OH 20% soln		315		440
phenylglycine USP		18400	25t	25600
NaOH flake 76%		6944		9660
acid chloride *		15000	TBC	20870
Et hexanoate		11760		16364

* 

3 chlorophenyl 5 methyl isooxazole 4 carboxylic acid

TBC to confirm

Δ sodium ethyl [illegible]

MANDERSTAM	CONSULTING ENGINEERS 2-10 HARBOUR YARD, CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page WP 62
		Made by	Rev.
		Checked by	Date

PROJECT

AMOXYCILLIN MWt 419.5 as trihydrate
365 anhydrous

PROCESS
1) make dane salt
2) dane salt + acid chloride → mixed anhydride
3) react with 6-APA

YIELD ~ 85-90% use 80%

BATCH SIZE

Basis one batch/day 75000 ÷ 300 = 250 kg bx

6-APA usage MWt 216 APA, MWt 419.5 amoxy tri

$= \frac{250}{419.5} \times \frac{216}{0.8} = \underline{161 \text{ kg/bx}}$

RAW MATERIALS

	MWt	Ratio	kg gross/bx	kg net/bx	kg/tonne (net) amox trihyd
Dane salt	301	1.05	235	235	940
6-APA	216		161	161	644
Acetone	NA	NA	225	170	700
CH_2Cl_2	NA	NA	300	240	960
MIBK	NA	NA	550	100	400
Et_3N	101	1.1	82	82	330
50% HCl					
NH_4OH					
Ethyl chloro carbonate	92.5	1.3	90	90	360

UTILITIES		per tonne amoxy	Pesos/tonne amoxy (WP 18B)	unit cost Pesos
Power	3.5 MWh/bx	14 MWh	34,080	2220
Water	6 m³/bx	24 m³	76	3.17
Steam	4 tonnes/bx	16 tonne	9600	600
	Dane salt WP 62		40824	NA
Total			81,580	NA

Dane salt consumption

$1.05 \times \frac{301}{0.8} \times \frac{250}{419.5} = 235$

587 kg glycine/tonne dane salt and

940 kg dane salt/tonne amoxycillin

587 × 0.94 = 551 kg glycine/tonne amoxycillin

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD, CHELSEA HARBOUR LONDON SW10 OXD	Job No.	Page NP [illegible]
		Made by	Rev.
		Checked by	Date

PROJECT

AMPICILLIN

MW 403.5 as trihydrate 349 anhydrous

Process : via Dane salt as amoxycillin

Batch size : as amoxicillin use same equipment

12000 ÷ 250 = 48 batches/year 250kg 6x

6-APA required @ 80% yield

$$\frac{250}{403.5} \times \frac{216}{0.8} = 167 \text{ kg 6APA}$$

RAW MATERIALS

	MWt	Ratio	kg (250 kg 6x net)	kg/tonne (Amp trihyd net)
Dane Salt	285	1.1	220	880
6-APA	216	1	167	668
[illegible]			170	680
[illegible]			240	960
[illegible]			100	400
[illegible]	[illegible]		55	220
[illegible]	[illegible]	3	93	372

Utilities : as ampicillin

Dane Salt requirements :

$$1.1 \times \frac{285}{[illegible]} \times \frac{250}{403.5} = 220 \text{ kg} ; 880 \text{ kg/tonne ampicillin}$$

558 kg phenylglycine → 1 tonne Dane salt

∴ 558 kg × .88 = [illegible] kg phenylglycine/tonne ampicillin

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD. CHELSEA HARBOUR LONDON SW10 OXD	Job No.	Page HP 32
		Made by	Rev.
		Checked by	Date

PROJECT

DANE SALTS for Amoxycillin & Ampicillin

Amoxycillin	Ampicillin
Dane salt HO-⟨O⟩-CH-COOK / N / Me C C CH_2 COOEt	Ph CH COOK / N / Me C CCH_2 COOEt
$C_{14}H_{16}NO_4K$ 301	$C_{14}H_{16}O_3K$ 285
yield 95% use 95%	Yield 95% use 95%
consumption/year 75 × 0.94 = 70.5 tonnes	15.6 × 0.88 = 13.7 tonnes
Batch size 1000 kg	1000 kg

Raw materials

	MW		kg/batch kg/tonne	kg/tonne amoxycillin		kg/ox = kg/tonne	kg/tonne ampicillin
KOH	56	1	195	183	(strength?)	195	172
EtOH	46	NA	177	166		177	156
Et aceto acetate	130	1.1	500	470		500	440
	—	—	—				
glycine	167	1	587	551		558	491 (× .88)
				(× .94)		(phenylglycine MW 151)	

P-hydroxyphenylglycine required $\frac{1000}{301} \times \frac{167}{.95} = 587$

HO-⟨O⟩-CH(NH$_2$)COOH ... $\frac{.95}{...}$ ... Dane salt

$C_8H_9NO_3$ MW 167 ... $C_{14}H_{16}NO_4K$ 301

Phenyl glycine reqd $C_6H_5\,CH\,(NH_2)\,COOH$ MW 151

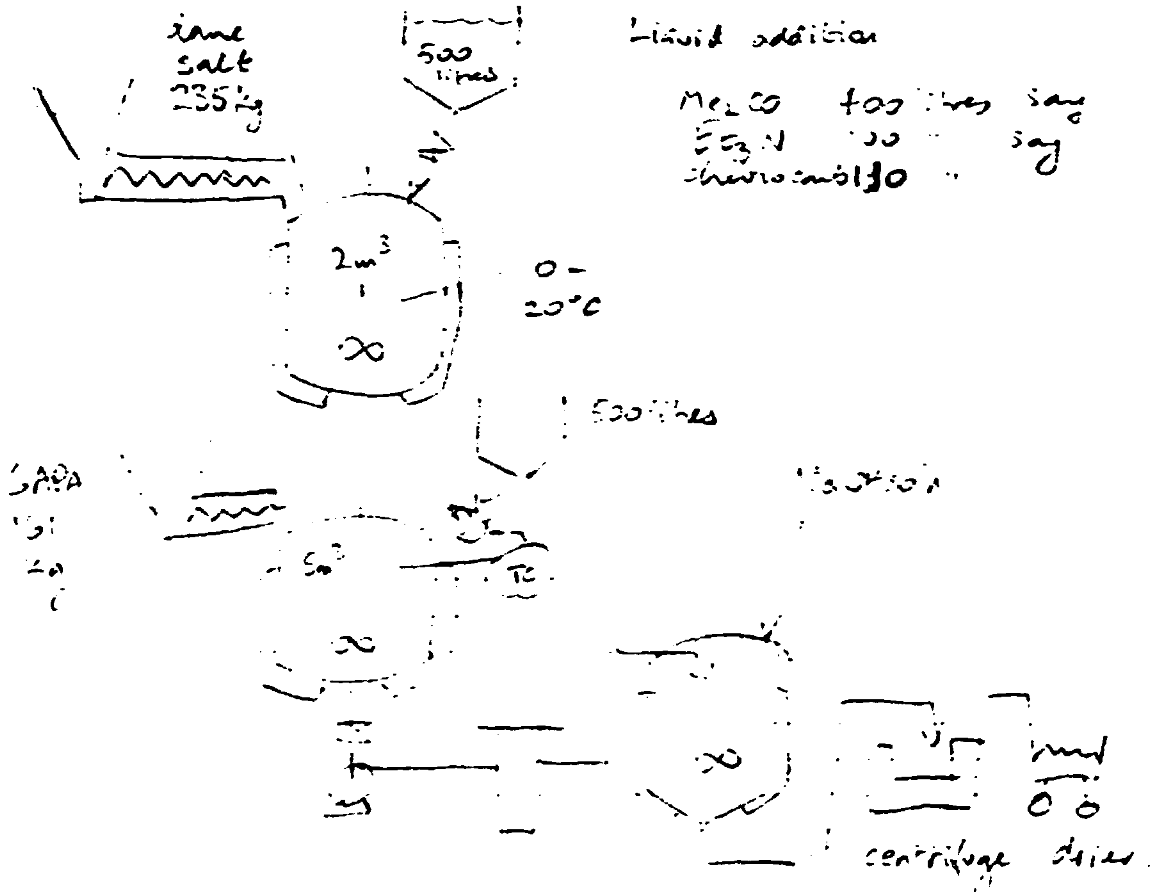
$(1000/285) \times (151/.95) = 558$ kg

UTILITIES:	per tonne Dane Salt	per tonne Amp/Amox	pesos/tonne
power	MWh/box	340 kWh	2087
steam	700 kg box	190 ...	120
water	2m³ ...	1.9 m³	6
		Total	2213 pesos

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD. CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page
		Made by	Rev.
		Checked by	Date

PROJECT

AMOXYCILLIN AMPICILLIN 250 kg batch EQUIPMENT



Liquid addition

Me_2CO 400 litres say
Et_3N 100 " say
chloroformate 130 "

Steps 2m³ reactor — Equipment 2m³ reactor

1. Acetone charge — cool — 500 litre feeder
2. Dane salt — " — "
3. Chloroformate addition — "
4. Amine addition — "

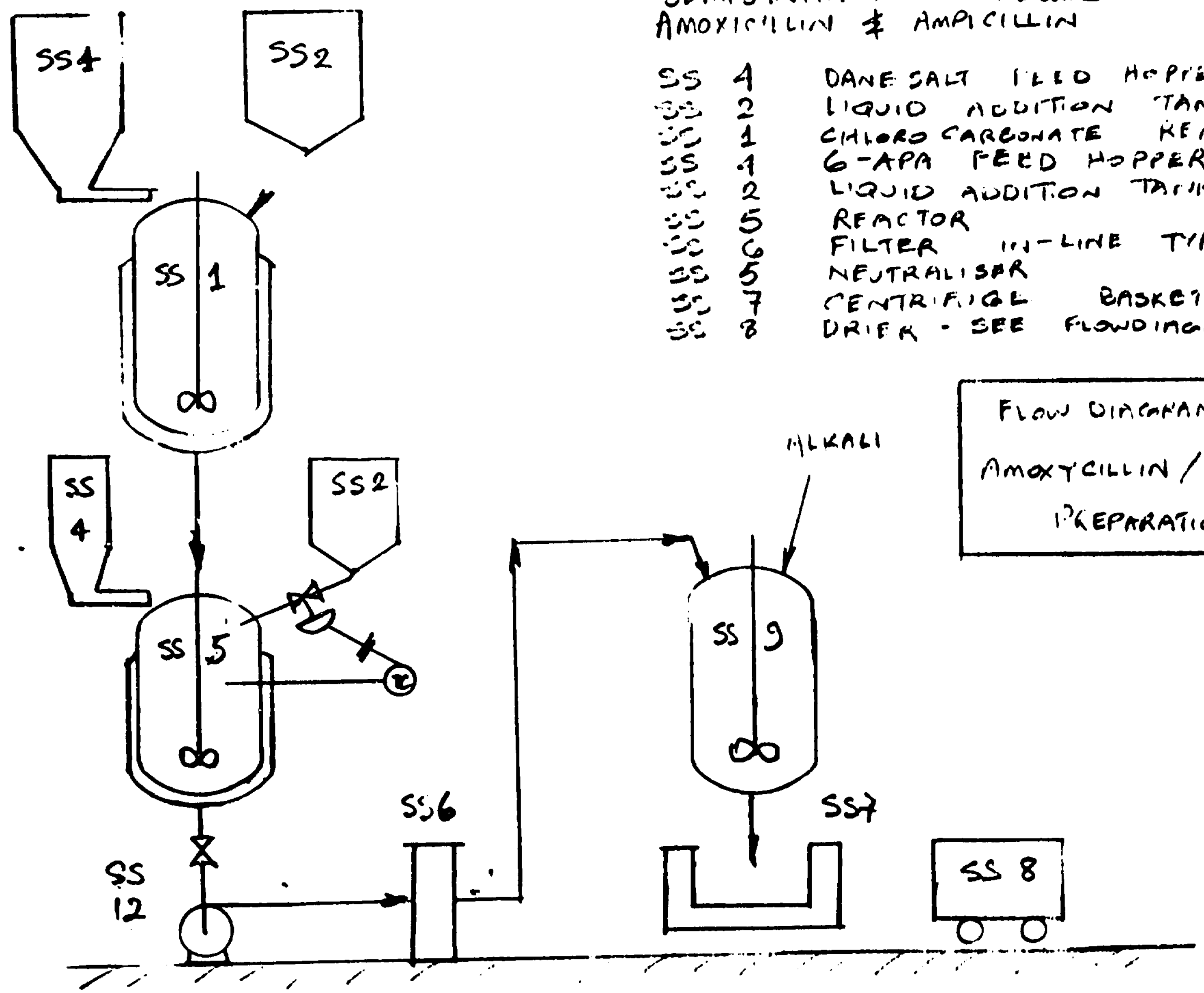
5m³ reactor

5. Acetone charge — cooling — 500 litre
6. 6APA charge — " — 1000 litre
7. cool -25°
8. Et_3N addition
9. anhydride mix addition
10. add 50% ... [illegible]
11. " MIOK/CH_2Cl_2 mix to ... [illegible]
12. Pump to filter
13. neutralise with ... [illegible]
14. centrifuge wash — 500 litre
15. ... [illegible] dryer — 500 "

SEMISYNTHETIC PENICILLINS
AMOXICILLIN & AMPICILLIN

SS	4	DANE SALT FEED HOPPER
SS	2	LIQUID ADDITION TANK
SS	1	CHLORO CARBONATE REACTOR
SS	4	6-APA FEED HOPPER
SS	2	LIQUID ADDITION TANK
SS	5	REACTOR
SS	6	FILTER IN-LINE TYPE
SS	5	NEUTRALISER
SS	7	CENTRIFIGE BASKET TYPE
SS	8	DRIER - SEE FLOWDIAGRAM 7.

FLOW DIAGRAM # 8
AMOXYCILLIN / AMPICILLIN
PREPARATION



WP 63A

MANDERSTAM CONSULTING ENGINEERS
2-10 HARBOUR YARD
CHELSEA HARBOUR
LONDON SW10 0XD

Job No	Page
Made by	Rev
Checked by	Date

PROJECT CONSUMPTIONS SEMI SYNTHETIC [illegible]

[illegible] CONSUMED — TONNES / YEAR — DELIVERED PRICE / TONNE

	kg/tonne	1995	96	97	98	99	2000	01	02	03	04	05	06	07	08	09	2010	$
AMOXYCILLIN + DANE SALT																		
Et aceto acetate	470	4.98	9.9	[illegible]	14.2	16.72	16.82	19.01	19.88	20.72	21.[illegible]	22.[illegible]	23.92	24.10	25.9	26.63	29.05	[illegible]
KOH	182	1.94	3.07	4.44	5.54	6.51	6.5[illegible]	7.42	7.74	9.01	8.58	9.34	9.32	[illegible]	10.08	10.9	11.21	4875
EtOH	166	1.76	2.79	4.03	5.03	5.58	[illegible]	[illegible]	7.02	7.32	7.4	7.02	8.45	8.86	9.15	9.71	10.26	1182
6-APA	640	6.82	10.82	15.65	19.5	22.93	23.96	26.15	27.24	28.4	30.01	31.10	32.72	34.38	35.68	37.67	39.8	
Acetone	700	7.42	11.76	17.01	21.2	24.32	25.26	28.42	29.61	30.87	32.02	33.81	35.63	37.38	38.57	40.95	43.26	1000
dichloromethane	960	10.17	16.13	23.33	29.03	34.18	34.37	38.57	40.61	42.34	44.74	46.37	49.16	51.26	52.89	56.16	59.33	905
M.I.B.K	400	4.24	6.72	9.72	12.12	14.24	14.32	6.24	16.92	17.64	18.54	19.32	20.36	21.36	22.04	23.4	24.72	1560
Et_3N	330	3.5	5.54	8.02	10.00	11.75	11.81	13.4	13.96	14.55	15.38	15.94	16.80	17.62	18.12	19.30	20.59	3895
50% HCl																		
NaOH																		
Ethylchloro carbonate	360	3.81	5.05	7.75	10.91	13.82	12.89	14.67	15.23	15.87	16.28	17.33	18.3	19.22	19.84	21.06	22.25	17400
phenoxyglycine	551	5.84	9.26	13.30	16.63	19.62	13.72	20.3	21.57	24.3	25.68	26.61	28.04	29.42	30.36	32.23	34.05	25600
utilities WP 60 teses x 10^6 year		0.864	1.37	1.98	2.47	2.90	2.92	3.31	3.45	3.59	3.80	3.34	4.15	4.35	4.49	4.77	5.04	
tonnes Ampicillin		10.6	16.2	24.3	30.3	35.6	35.8	40.6	42.3	44.1	46.[illegible]	48.3	50.9	53.4	55.1	58.5	61.8	—
AMPICILLIN + DANE SALT																		
6-APA	668	3.21	4.4[illegible]	5.54	6.6[illegible]	6.67				6.21	6.0[illegible]	5.54				4.47		
Me_2CO	680	3.26	4.49	5.64	[illegible]	6.8				6.32	6.15	5.64				4.55		1200
CH_2Cl_2	960	4.61	6.38	7.97	[illegible]	9.6				7.33	[illegible]	4.97				6.47		905
M.I.B.K	400	1.92	[illegible]	[illegible]	3.56	4.0				3.47	3.44	3.32				2.68		1560
Et_3N	340	[illegible]	2.24	[illegible]	3.37	3.4				3.16	3.0[illegible]	2.82				[illegible]		3895
NaOH																		
Cl-COOEt	372	1.49	2.45	[illegible]	3.68	3.72				3.46	3.38	[illegible]				2.49		17400
phenyl glycine	491	2.36	3.24	4.08	4.26	4.9				4.56	[illegible]	4.07				3.29		25600
KOH	172	.82	1.14	1.43	[illegible]	1.72				[illegible]	1.5	1.42				1.15		4870
EtOH	156	.74	1.03	1.22	1.54	1.56				[illegible]	1.4	1.20				1.04		1182
$MeCOCH_2COOEt$	440	4.8	[illegible]	3.65	4.35	4.4				4.0[illegible]	4.[illegible]	3.65				[illegible]		3070
utilities WP60 teses x 10^6/year		0.39	.53	[illegible]	[illegible]	0.81	→		→	0.76	0.74	0.68	→		→	0.55	→	
tonnes ampicillin		4.8	6.6	[illegible]	[illegible]	10				[illegible]	[illegible]	8.3				6.7		—
CLOXACILLIN																		
6-APA	570	0.51	0.57	1.71	2.28	2.91			3.48	3.53		4.10	4.67	4.73	5.24	6.38		—
MEK	2500	2.25	2.5	7.5	10.0	12.75			15.25	15.5		18	20.5	20.75	23	28		1560
acid chloride	714	.64	.91	2.14	2.86	3.64			4.35	4.43		5.14	5.85	5.92	6.57	8		21000
NaOH	1.6	.10	0.12	0.35	0.46	0.59			0.71	0.72		0.83	0.95	0.96	1.06	1.3		9660
Me_2CO	1250	1.12	1.25	3.75	5.00	6.37			7.62	7.75		9	10.25	10.37	11.50	14		1400
NaC_6H_{13}	480	.43	.48	1.44	1.92	2.45			2.93	2.97		3.46	3.94	3.98	4.42	5.38		16365
utilities WP 65 teses x 10^6/year		0.043	0.05	[illegible]	[illegible]	0.246			0.294	0.3		0.347	0.395	0.4	0.443	0.540		
tonnes cloxacillin		0.9	1.0	3	4	5.1	→		6.1	6.2	→	7.2	8.2	8.3	9.2	11.2	→	—

Notes: tonnes cloxacillin/amoxicillin/ampicillin [illegible] WP1 WP2

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD. CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page
		Made by	Rev.
		Checked by	Date

PROJECT

SAME SALT EQUIPMENT REQUIREMENTS 1000 kg

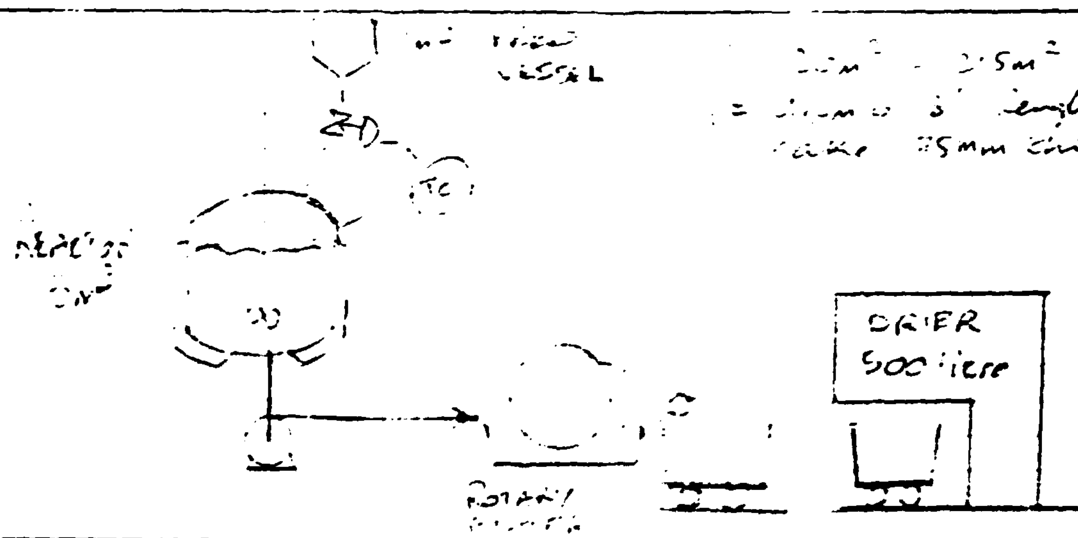
N

1000 kg

350 litres

500 litres

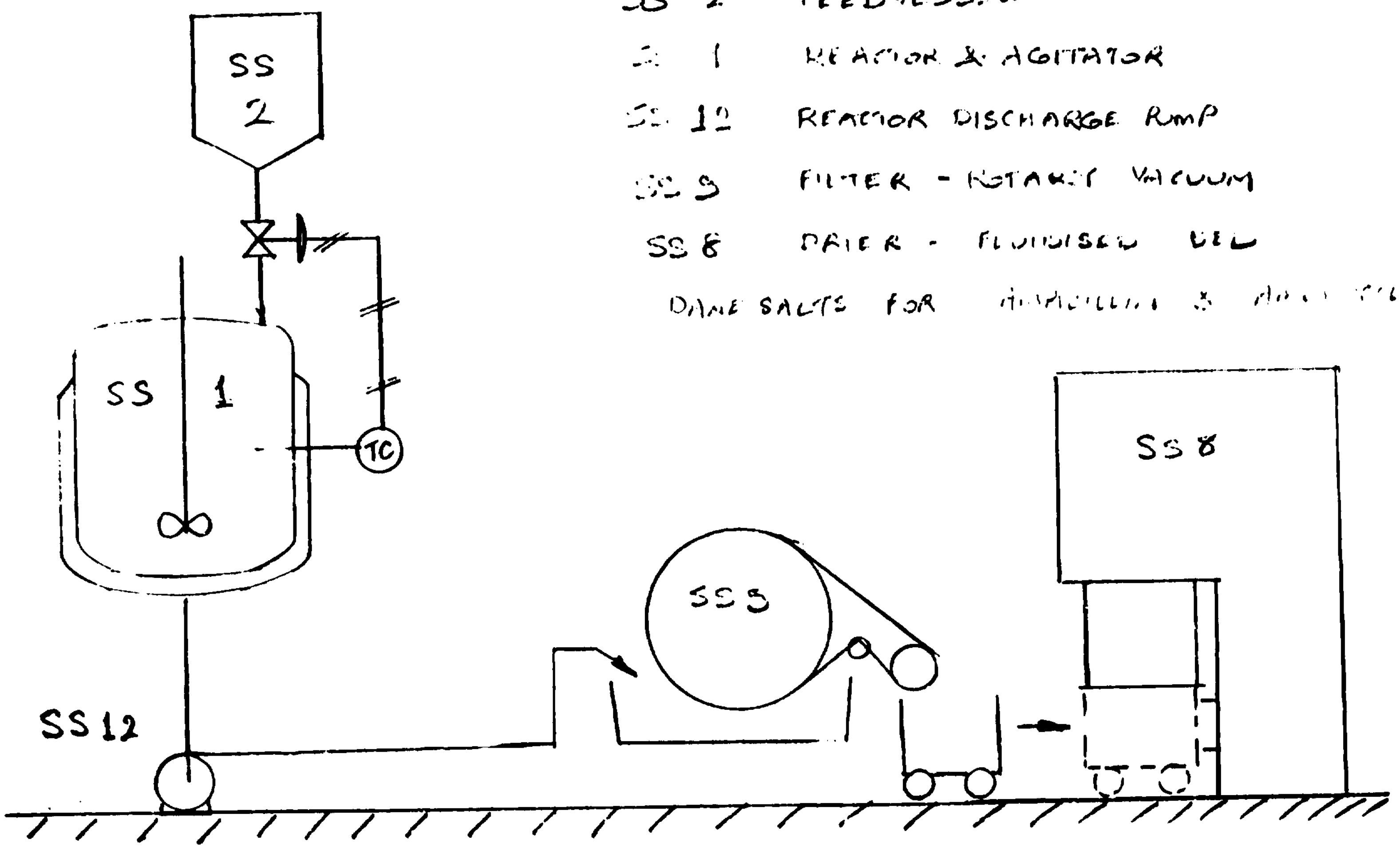
75mm thick



WP 64B

SS 2	FEEDVESSEL
[illegible] 1	REACTOR & AGITATOR
[illegible] 12	REACTOR DISCHARGE PUMP
[illegible]	FILTER - ROTARY VACUUM
SS 8	DRIER - FLUIDISED BED

DANE SALTS FOR [illegible] & [illegible]



FLOW DIAGRAM NO 7

TITLE : DANE SALT PREPARATION

MANDERSTAM	**CONSULTING ENGINEERS** 2/10 HARBOUR YARD, CHELSEA HARBOUR LONDON SW10 OXD	Job No.	Page [illegible]
		Made by	Rev.
		Checked by	Date

PROJECT

CLOXACILLIN   sodium cloxacillin monohydrate

[illegible] MW 476

Process: react [illegible] chloride with 6-APA

Batch size: [illegible] tonnes year [illegible] kg batches
[illegible] batches year @ 80% yield

RAW MATERIALS

	[illegible]	[illegible]	net kg / ox	net kg tonne Cloxacillin
6-APA	[illegible]		[illegible]	570
[illegible]			550	2750
[illegible] chloride	[illegible]		[illegible]	[illegible]
[illegible]	40		23	[illegible]
[illegible]			250	[illegible]
[illegible]	[illegible]		[illegible]	120
[illegible]			[illegible]	450

[illegible]

[illegible]

6-APA [illegible]

UTILITIES:

			per tonne Clox	Pesos / tonne Cloxacillin
[illegible]	[illegible]	15	[illegible]	33 300
[illegible]	[illegible] tonnes [illegible]	[illegible]	[illegible]	7 500
[illegible]	[illegible]	[illegible]	[illegible]	24
				40 824

Cost [illegible]

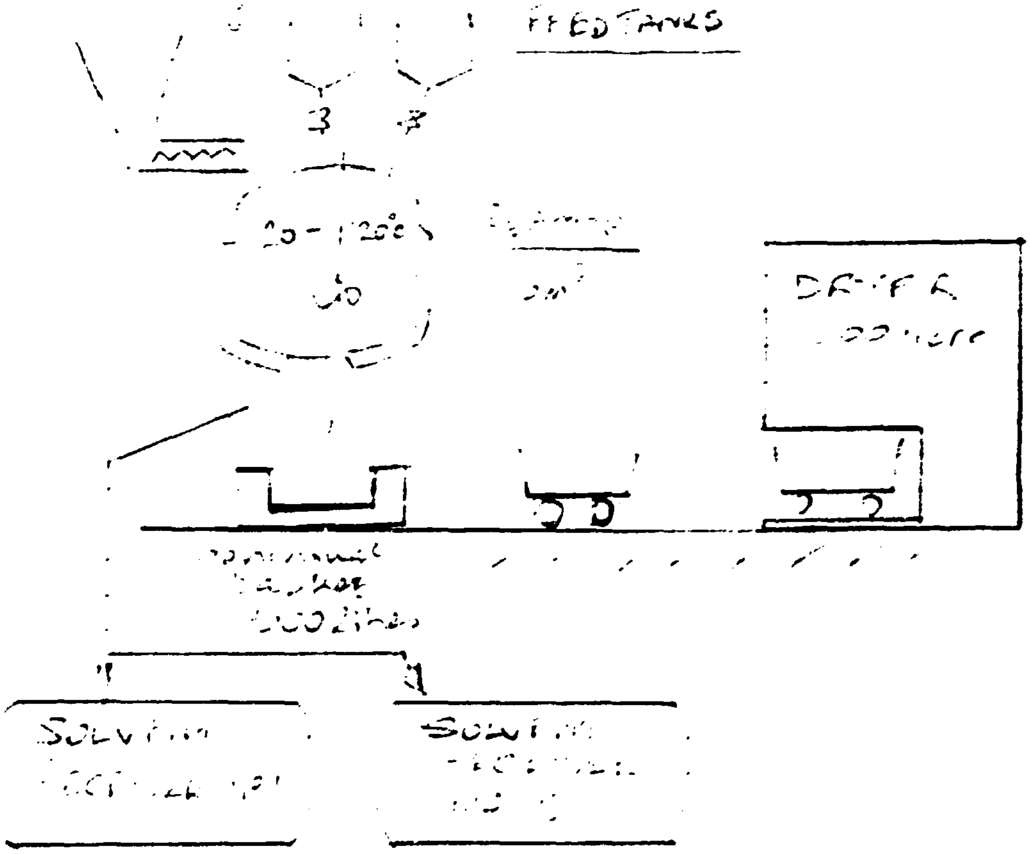
MANDERSTAM	**CONSULTING ENGINEERS** 2/10 HARBOUR YARD, CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page WP 66
		Made by	Rev.
		Checked by	Date

PROJECT

CLOXACILLIN MANUFACTURE 200 kg batch

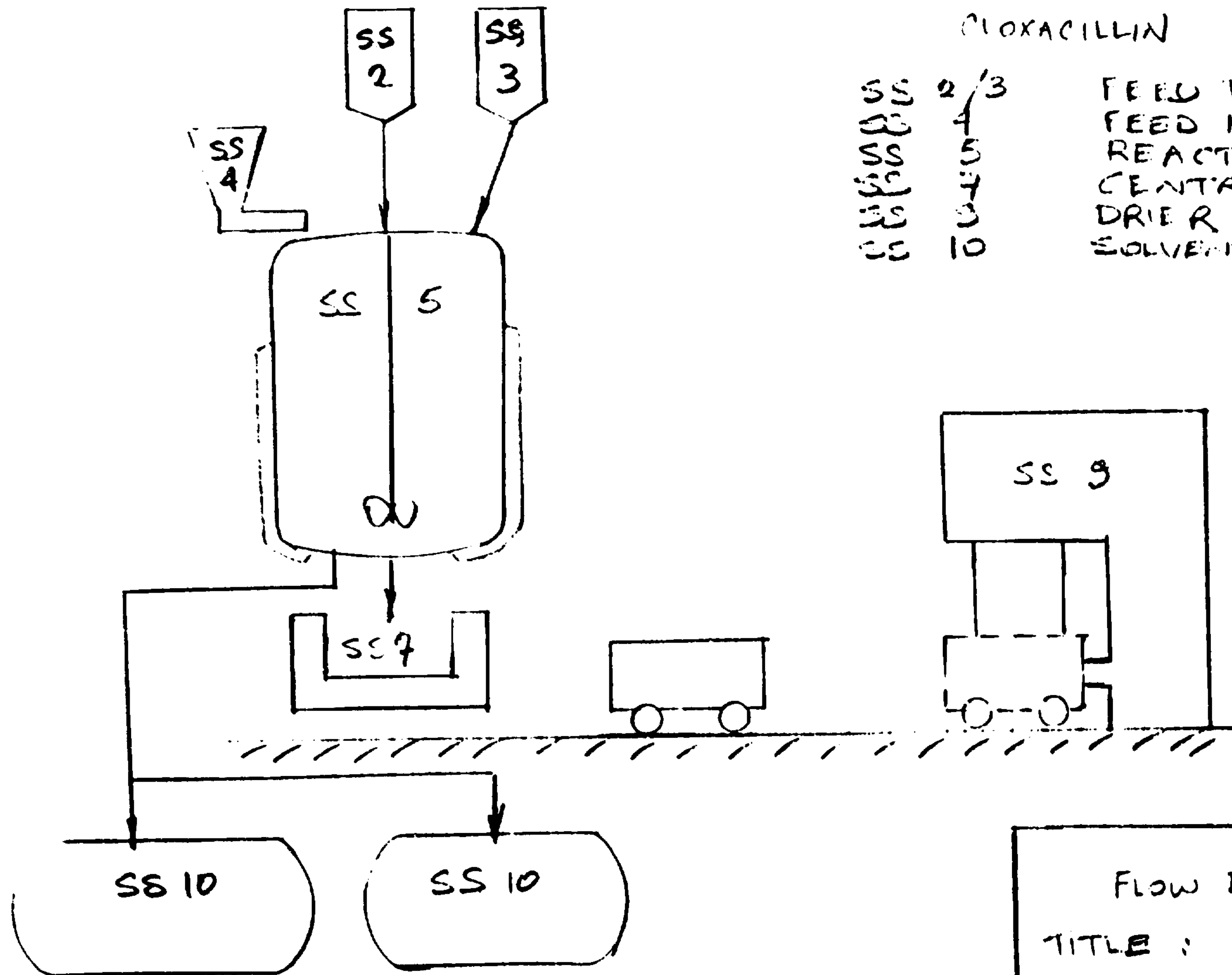
STEPS 6m³ reactor

			Equipment	Equipment
1	charge	[illegible]		2000 litre vessel
2	"	NaOH [illegible]		200 " "
3	"	6-APA		metering feeder
4	add	[illegible]		2000 litre vessel
5	"	CH_2Cl_2		" "
6	Dump out aqueous phase			$5 m^3/h$
7	add	[illegible]		
8	remove	[illegible]		
9	[illegible]			
10	add	[illegible]		
11	[illegible]			500 litre
12	[illegible]			" fluid bed



CLOXACILLIN

SS	2/3	FEED TANKS
SS	4	FEED HOPPER
SS	5	REACTOR
SS	7	CENTRIFUGE
SS	9	DRIER
SS	10	SOLVENT RECEIVER.



FLOW DIAGRAM No 9

TITLE : CLOXACILLIN PREPARATION

WP 66A

UNIDO : Philippines SEMISYNTHETIC SS Penicillin G Equipment List

ITEM REF	Description of item.	Capacity or size	Mat of constⁿ	No. off	Quoted yes	Quoted no	$ price
SS 1	Reactor agitator + jacket	$3m^3$	316	3			
SS 2	Feed tank 500 litre	500 litre	316	3			
SS 3	" " 2000 litre	$2m^3$	"	2			
SS 4	Metering screw feeder 3000 litre/hour		"	3			39,000
SS 5	Reactor agitator + jacket	$6m^3$	"	2			
SS 6	In-line filter		316				
SS 7	centrifuge basket type	500 litre	316	2			
SS 8	fluid bed drier	"	"	2			
SS 9	Rotary vacuum filter	$20m^2$	"	1			
SS 10	Receiver tanks	$5m^3$	"	4			
SS 11	Solvent Recovery unit 500 litre/h boilup rate	500 lit/h	"	1			
SS 12	Transfer Pumps centrifugal 3 barg	$4m^3/h$	"	4			
SS 13	Transfer Pumps gear " " "	" "	"	4			

WP 67.

MANDERSTAM	**CONSULTING ENGINEERS** 10 HARBOUR YARD, CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page NP68
		Made by	Rev.
		Checked by	Date

PROJECT LABOUR - OPTION II PENG + 6-APA ONLY

ORGANISATION CHART - FUNCTIONS

GENERAL MANAGEMENT

COMMERCIAL	PRODUCTION	LABORATORY	ENGINEERING
SALES	FERMENTATION	STRAIN DEVELOP	UTILITIES
ADMINISTRATION	EXTRACTION	ANALYTICAL	MAINTENANCE
PURCHASING	6-APA	QUALITY CONTROL	PILOT PLANT
FINANCE			SAFETY
PERSONNEL			

SALARIES

	Pesos/year	
DIRECTORS	500.000	Chief Executive
S-MANAGERS	250.000	
SUPERVISORS	180.000	Degree level experienced
TECHNICIANS	120.000	"
WORKERS SKILLED	80.000	Experienced [illegible]
UNSKILLED	40.000	[illegible]

HEAD COUNT

	No	SALARY		Pesos/year $\times 10^6$
CHIEF EXECUTIVE	1	500.000	=	0·50
SENIOR MANAGERS	4	250.000	=	1·00
SUPERVISORS	27	180.000	=	4·86
TECHNICIANS	41	120.000	=	4·92
WORKERS S	40	80 000	=	3·20
" U	42	40.000	=	1·68
	155			16·16

HEAD COUNT

	TOTAL	COMMERCIAL	PRODUCTION	LABORATORY	ENGINEERING
S-MANAGERS	4	1	1	1	1
SUPERVISORS	27	1	10	8	8
TECHNICIANS	40	5	13	9	8
SKILLED WORKERS	40	2	12	8	18
UN " "	42	2	20	-	20
CHIEF EXEC	1				
	155				

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD. CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page WP69
		Made by	Rev.
		Checked by	Date

PROJECT

(for OPTIONS I and II ADD TO OPTION III

ADDITIONAL STAFF FOR SEMI-SYNTHETICS

			SALARIES Per year Pesos $\times 10^6$
SENIOR MANAGERS	1	SALARY TOTAL	0·25
SUPERVISORS	4	"	0·72
TECHNICIANS	8		0·96
SKILLED WORKERS	8		0·64
UN " "	8		0·32
			2·89

ADDITIONAL STAFF FOR DOSAGE PENICILLIN

SENIOR MANAGERS	1	0·25
SUPERVISORS	1	·18
TECHNICIANS	6	·72
SKILLED WORKERS	8	·64
UNSKILLED "	4	·16
		1·95

PSE CHECK SALES & MARKETING WITH N MULLINEUX

OPTION II = 6-APA (below) PLUS DOSAGE + SEMI-SYNTH from above.

6-APA PLUS GENERAL MANAGEMENT :—

GENERAL MANAGEMENT

COMMERCIAL	PRODUCTION	LABORATORY	ENGINEERING
ADMIN	6-APA	QC	UTILITIES
PURCHASE	SEMI-SYNTH		MAINTENANCE
SALES	DOSAGE		SAFETY

	TOTAL	COMMERCIAL	PRODN	LAB	ENGINEER
SENIOR MANAGERS	3	1	1		1
SUPERVISORS	16		8	4	4
TECHNICIANS	21	1	8	8	4
SKILLED WORKERS	18	2	8	4	4
UNSKILLED WORKERS	10	2	4	2	2
CHIEF EXEC	1	1			
TOTAL	69				

MANDERSTAM

CONSULTING ENGINEERS
2 10 HARBOUR YARD
CHELSEA HARBOUR
LONDON SW10 OXD

Job No.		Page	WP 70
Made by		Rev.	
Checked by		Date	

PROJECT [illegible]

SPLIT INTO capsules 80%, powders in vials 20%
(per NM [illegible] report section 3.8) see WP 60

maximum o/p period [illegible] 2010

	ampicillin %	amoxicillin cloxacillin	penicillin G
capsules	70	70%	-
liquids/syrups	5	[illegible]	-
[illegible]	5	5	
vials	20	5	100%

Decided: to ignore [illegible] difficulty in selling this product in developed market

OUTPUT + Plant design based on :-

[illegible] - 9.0 tonnes/year

[illegible] 75 [illegible] - 3 tonnes/year

25 [illegible] - 1 tonne/year

[illegible] tablets

UTILITIES

		per year	Pesos xM
steam	0.05 [illegible]/h × 12 × 300	180 tonnes	0.108
power	25 kWh × 12 × 300	30,000 kWh	0.20
water	[illegible] × 300	1500 m^3	neg
			0.40 /year

basis 300 [illegible] single shift

[illegible] steam 300 ₮/tonne
power [illegible] city water [illegible] ₮/m^3

independent [illegible]

WP 71

Production of dosage forms of ampicillin, amoxycillin and cloxacillin.

1. A postulated production programme. The starting point for postulating a programme is the suggestion that a total of about 9 tonnes of these three antibiotics will be produced annually. It is first necessary to make assumptions as to the relative proportions of the individual antibiotics that will be produced and, for each one, the proportions of the various dosage forms. The next phase is to examine the feasibility of economic production of the quantities arising from these assumptions.

1.1 Development of a tentative programme. The British Pharmacopoeia describes injections for both ampicillin and cloxacillin but not for amoxycillin. It is believed that the demand for injections is relatively small. The assumptions that are made for this study are:

antibiotic	annual production	dosage form	dosage form as percent	dosage form as weight
amoxycillin	4 tonnes	capsules	75%	3000kg
		dry syrups	25%	1000kg
ampicillin	4 tonnes	capsules	70%	2800kg
		dry syrups	25%	1000kg
		injections	5%	200kg
cloxacillin	1 tonne	capsules	70%	700kg
		dry syrups	25%	250kg
		injections	5%	50kg .

1.2 Feasibility of the tentative programme. The injections described in the pharmacopoeia are of the same form as for injection of bemzylpenicillin and so could be made as a small addition to the large scale programme to manufacture benzylpenicillin injection. They are not considered further in this section of the report

All capsules would be produced using the same manufacturing facilities similarly all dry syrups would be produced using the same manufacturing facilities.

The total weights of antibiotics used annually in the two dosage forms would be:

capsules	6500kg
dry syrups	2250kg

Consider now what these quantities mean in terms of unit doses and unit containers.

(1) capsules. The most commonly used strength is 250mg; less commonly used is the 500mg strength. Assuming 90% will be 250mg and 10% will be 500mg, it follows that the number of capsules produced annually would be:

$$\frac{6500 \times 1000}{[(0.9 \times 0.25) + (0.1 \times 0.5)]} = 23,636,364$$

say 24 million capsules annually or 80,000 daily.

Compare this figure with the expected output of a modern automatic capsule filling machine. A machine of moderate capacity has a claimed filling rate of 400 capsules/hour. Suppose that in practice a rate of 350 capsules/hour is attained and the machine operates, on average, 6 hours per shift. The daily output would be 350 x 60 x 6 = 126,000.

Now consider the packing rate:

It is proposed that capsules will be packed in plastic tubs with tamper-evident closures and that 90% will be packed in 500's and 10% in 100's. Assume a packing rate of 10/minute for the 100's and 5/minute for the 500's. Thus, the time to pack 80,000 capsules would be:

for the 100's

80,000 x 0.1/ 100 x 10 = 8 minutes

for the 500's

80,000 x 0.9/500 x 5 = 29 minutes

It is clear that such machines for both manufacture and packaging would be operating at far less than their capacity and that an operation on this scale wuld be uneconomic.

(2) dry syrups. These are commonly presented as a dry powder consisting of 20 doses of antibiotic in a flavoured base for the preparation of 20 x 5ml doses. As this dosage form is for children, the dose may be lower. Both 125mg and 250mg doses are commonly used. Assuming equal numbers of the two strengths are produced the number of 20-dose bottles would be:

$$\frac{2250 \times 1000}{[(0.5 \times 0.25) + (0.5 \times 0.125)] \times 20} = 600{,}000$$

or 2000 daily.

The total weight of antibiotic plus excipients in each bottle may be around 20 - 40g. Assuming 30g/bottle and that 2000 bottles corresponds to one batch then the batch size would be:

$$30 \times 2000/1000 = 60\text{kg}$$

Whilst there is no problem in working with suitable equipment for this scale of operation, it is very small. Costs of both production and quality control would be reduced by working on a larger scale.

Again, considering filling into bottles, a machine filling at the rate of 30 bottles/minute would complete the day's production in:

$$2000/30 = 67 \text{ minutes.}$$

Thus, on consideration of both production and packaging, a much increased scale of operations is desirable.

2 A minimum scale programme. A programme is proposed in which production would be about 1.5 to 2 times greater than initially envisaged. There would be shared facilities for weighing, sifting and blending of powders for the manufacture of capsules and dry syrups. Some packing facilities would also be shared.

2.1 Bulk blending. Facilities for weighing, sifting and blending of powders would be based on batch sizes of about 180 - 250kg. This would correspond to 750,000 capsules or 6000 bottles of dry syrup.

2.2 Capsule filling. Assuming a mean weight of capsule contents [antibiotic + excipients] of 300mg, a batch of 750,000 capsules would weigh 225kg. Such a batch would be filled in six days using a machine of maximum capacity 400 capsules/minute.

2.3 Capsule packing. Making the same assumptions as in 1.2 (1), a batch of 750,000 capsules would be packed on average in about 6 hours.

2.4 Filling and packing of dry syrups. Making the same assumptions as in 1.2 (2), a 180kg batch of dry syrup [6000 bottles] would be packed in about 3.5 hours.

2.5 Plant capacity and utilization. The capacity and utilization in the proposed programme is illustrated in the chart, figure 1 which shows a possible production programme during a period of 20 working days.

It is suggested that up to 5 batches of blended powders could be produced in one shift. The chart starts with a run of three batches of bulk powder for capsules [of the same antibiotic] which could be prepared in one day leaving time for clean up so as to start a different product the next day. The chart then shows a run of 5 batches of dry syrup in one day. A day free from production would leave ample time for clean up thus enabling manufacture of a different product the following day. In this programme the batching/blending facility would be used for only 4 of the 20 working days.

Capsule filling would occupy 18 of the 20 working days.

The lines for filling/packing of dry syrups and for packing of capsules would operate 9 and 3 days respectively for the for the two dosage forms.

This production programme corresponds to the following outputs:

	20 working day period	300 working day period
capsules	2,250,000	34,000,000
dry syrups [bottles]	90,000	1,350,000
[doses]	1,800,000	27,000,000

Assuming an average dose of 275mg for capsules [90% 250mg and 10% 500mg] and 187.5mg for dry syrups [equal numbers of 125mg and 250mg] these annual figures represent:

weight of antibiotic in capsules	9.3 tonnes
weight of antibiotic in dry syrups	5.1 tonnes
total	14.4 tonnes

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD, CHELSEA HARBOUR LONDON SW10 0XD	Job No. Made by Checked by	Page WP75 Rev. Date

PROJECT DOSAGE SECTION

RAW MATERIALS & PACKAGING

CAPSULE PACKING $ per 1000 capsules

$ tonne product

empty capsules $\frac{23,636,364}{6.5 \times 1000} \times 2$ = 7272 " "

bottles $\frac{2100 \times 300 \times 0.225}{6.5}$ = 21807.7 " "

2100 bottles / shift 300 days / year
$ 0.225 per bottle
6.5 tonnes product per year)

trays $\frac{175 \times 300 \times 0.05}{6.5}$ = 404 " tonne

(175 trays / shift $ 0.05 / tray)

shrink wrap $\frac{175 \times 300 \times 0.08}{6.5}$ = $ 646 " "

Total packaging raw mats / tonne $ 30,129 " "

SYRUP FILLING / PACKING

bottles + caps $\frac{600,000 \times 0.15}{2.25}$ $ 40,000 " "

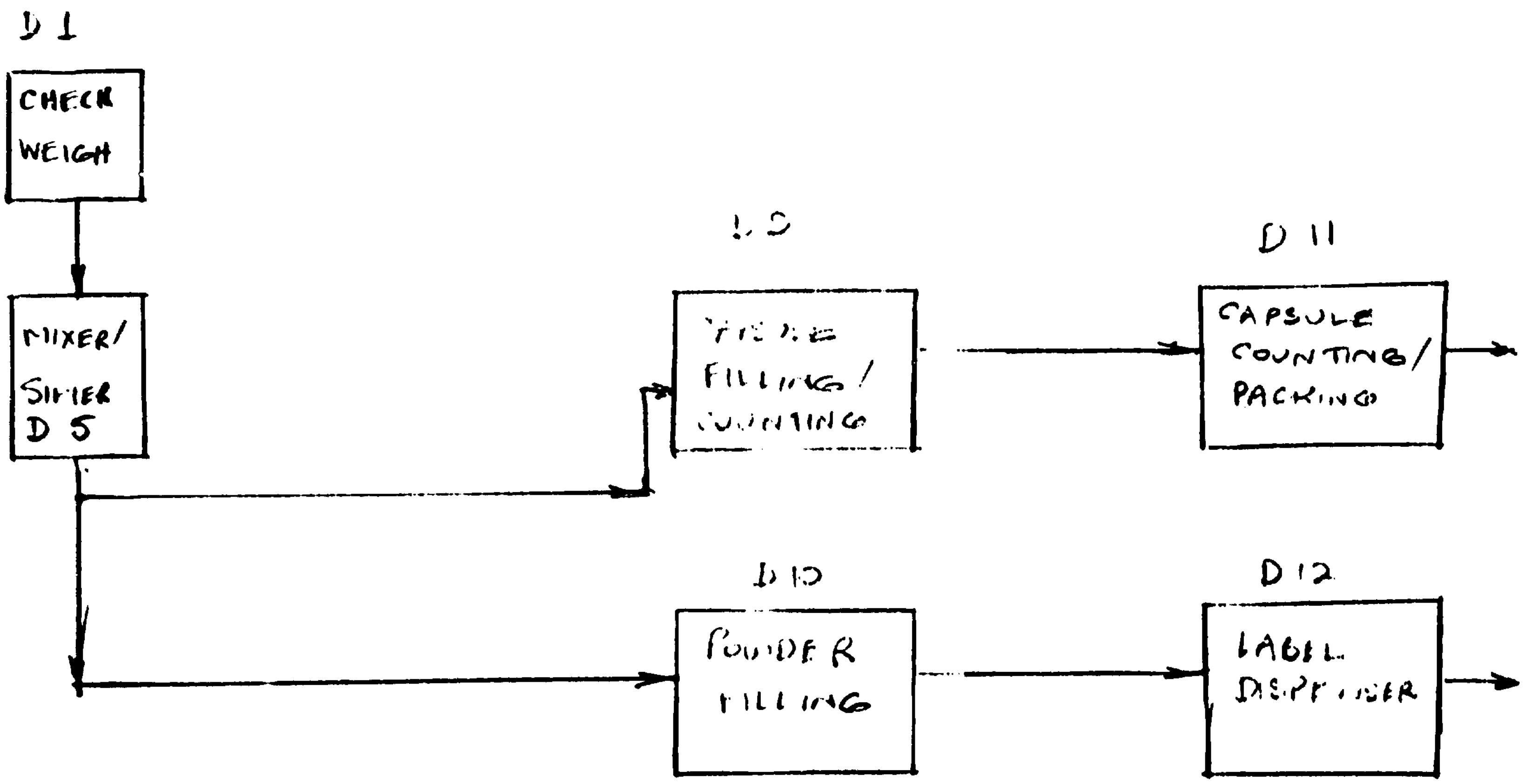
(600,000 bottles / year 2.25 tonnes / year
$ 0.15 / bott)

trays + shrink wrap
1000 × 300 × 0.13 / 2.25 16,000

(1000 / shift, 300 days / year 0.13 $) $ 56.000 / tonne

Composite cost per tonne product

(.75 × 30,129) + (.25 × 56,000) =
22597 + 14000 = $ 36597 / tonne



FLOW DIAGRAM # 10
DOSAGE

WP 75A

a SB 22/1 WP 76

Philippines Dosage Section D — Penicillin G — Equipment List

Description of item.	Capacity or size	Mat of constⁿ	No. off	Quoted yes	Quoted no	$ price
weigh scales	300kg		1			1500
containers	100l	316	2			1400
" "	20l	"	2			200
sifting machine 5 kg/min			1			6000
powder blender	$1m^3$	316	1			12,000
scoops 2 sets			2sets			100
weigh scales	6kg		1			1200
vacuum cleaner	450W		1			300
capsule filling machine	400/min		1			170,000
powder filling machine + conveyor	30/min		1			32400
capsule counting/ m/c + conveyor	5–10 per min		1			51800
self adhesive label dispenser			1			3000
check weight balance			1			700
foot operated lid closer						1100
~~shrink~~ wrapper "L" sealer			1			3100
shrink tunnel			1			9870
pallet truck			1			500
batch number/exp date printer			1			15120

MANDERSTAM

CONSULTING ENGINEERS
2/10 HARBOUR YARD,
CHELSEA HARBOUR
LONDON SW10 0XD

Job No.	Page WP 22
Made by	Rev.
Checked by	Date

PROJECT DOSAGE SECTION GCH 22/1

THROUGHPUT WP + CHART 3 TONNES/YEAR O/P

	1995	'96	'97	'98	99	00	01	02	03	04	05	06	07	08	09	2010
CAPSULES (75% TOTAL)																
PENICILLIN V																
AMPICILLIN (·75 × ·78)	·11	0.29	·40	·46	·58	→	→	→	·46	→	→	→	→	→	→	→
AMOXYCILLIN (·75 × ·85)	·35	0.82	1.12	1.53	1.94	2.12	2.23	2.23	2.47	2.57	2.65	2.82	2.94	3.06	3.24	3.35
CLOXACILLIN (·75 × ·35)	·07	—	0.14	·21	·285	—	—	—	·36	—	0.43	—	0.5	—	0.57	→
TOTALS	0.53	1.18	1.66	2.2	2.8	2.98	3.09	3.16	3.29	3.41	3.54	3.71	3.9	4.02	4.27	4.38
SYRUPS 25% (% 3)	0.18	0.39	0.55	·73	·93	·99	1.03	1.05	1.09	1.14	1.18	1.23	1.3	1.34	1.42	1.46
TOTAL	0.72	1.56	2.2	2.92	3.72	3.96	4.12	4.2	4.36	4.56	4.72	4.92	5.2	5.36	5.68	5.84
COSTS																
PACKAGING $ $\times 10^3$	26.3	57.09	80.51	106.86	136.14	144.9	150.7	153.7	159.5	166.9	172.7	180	190.3	196.2	207.8	213.7
UTILITIES Pesos $\times 10^6$	←	←	←	←	←	←	1.4	→	→	→	→	→	→	→	→	→

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD, CHELSEA HARBOUR LONDON SW10 OXD	Job No.	Page WP 78
		Made by	Rev.
		Checked by	Date

PROJECT UTILITIES OPTION III

OPTION THREE UNIDO — Pen G and 6-APA production

STEAM

WP N°	tons/batch	area	summarised on WP	av tonne/h *	%
18B	120 tons/batch	fermentation / extraction	20	1.446	58.7
54	1.67 tons/tonne	6-APA	56	0.013	0.52
	1.0 tonne/hour	miscellaneous	(1452 ton fuel/year =)	1.00	40.65
				2.46	

(* basis 300 ton/year penicillin 2.871 ton/bx.
20.0 " " 6-APA.
365 day/year 24h/day = 8760 hours)

Boiler Installed capacity 2 × 5 tonne/h. 6 bar

POWER

	MW		
18.B	279 mw/batch	fermentation test^{n}	3.3 MW/hour
54	1.2 " "	6-APA.	0.050 MW/hour
	Solvent recovery		0.03 "
	miscellaneous		0.25 "
	boilers		0.04 "
	cooling water pumps/towers		0.33 "
	Totals		4.00 MW/hour

Power installed capacity 8MW.
Standby capacity 8MW.

WATER.

18B	135 ton/batch	1.61 m^3/h.
54	2 ton/batch	0.83 m^3/h
	washing	5.0 " "
	boiler	1.3 " "
	cooling tower make-up	170.0 " "
	compressors etc	1
	Totals	180 " "

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD. CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page WP 79
		Made by	Rev.
		Checked by	Date

PROJECT UTILITIES OPTION I

OPTION I PENG, 6-APA AS SHEET WP78 PLUS SEMI-SYNTHETICS & DOSAGE

STEAM		tonne/hour
6-APA and Penicillin from previous sheet		2.46
Semi synthetics	
note 1. amoxycillin basis 50 t/y		0.66
ampicillin " 10 " "		0.13
2 cloxacillin " 5t/y	neglig	0.01
dane salt " 1901	neglig	0.01
dosage + unaccounted 0.19 t/h		1.00 tonne/h
Fuel 2042 ton oil (4)		2042 ton oil/year

POWER			kW/h
amoxy	14 MWh/tonne	700 MW/year	88
ampi	" "	140 " "	18
clox.	15 MW/tonne		10
dane salt	940 kW/tonne amox + ampi		7
unaccounted (dosage etc. WP70 = 25 kW)			20
			135

WATER		litres/h
amoxy	24 m³/tonne product	150
ampi	" " "	30
clox	7.5 " " "	neg
dane	1.9 " " "	15
dosage	washings etc. WP70	200
		400

Notes

1. Basis 50 ton/y amoxycillin 16 tonnes steam per day ·66 t/h
2. 12.5 tonnes steam / ton clox
3. 190 kg steam / ton amoxy + amp.
4. Fuel oil consumption per ton steam

$\frac{970.6 \times 1000}{7.000 \quad ...2}$ = ... kg × 8760 = 590 ton fuel / ton steam

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD. CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page WP 80
		Made by	Rev.
		Checked by	Date

PROJECT UTILITIES OPTION II

OPTION II ..... 6-APA - Semi synthetics + dosage only

STEAM		av tonne/h	assumed max. t/h	equipment rating t/h
	6-APA	0.013		
	semi syn + dosage	1.000		
	others	0.5		
	total	1.51.	3.0 t/h	5 t/h.

fuel oil 891 ton/year

POWER		av kW/h	max kW/h	
	6-APA	50		
	semi s + dosage	135		
	others	100		
		250	500	1000 kW/h

WATER		litres/h		
	6-APA	830		
	Semi.sy + dose	400		
	others	500		
		1750	3500	$10 m^3/h$.

SUMMARY

OPTION	(Pen G + 6APA only)		pesos/year	rating.
III	steam	21550 ton/year	12.9×10^6	10 t/h
	power	35040 MW/year	77.78 "	8 MW
	water	$1.577\ m^3 \times 10^6$/year	5 "	$60 m^3/h$
			95.68 "	

I (add semi synthetics and dosage to above option III)

steam	8760 + 21550 = 30310 t/y	18.18×10^6
power	1182 + 35040 = 36222 "	80.4×10^6
water	.003 + 1.577 = 1.58×10^6	5.0 "
		103.5

II (subtract Penicillin G from option II)

steam	30310 − 21462 = 8848	5.3×10^6
power	36222 − 34602 = 1620	3.396×10^6 pesos
water	1.58 − 1.56 = 0.02×10^6	63.400 Pesos
total		8.968×10^6 pesos/year

NIDO : Philippines

UTILITY SECTION "U"
Penicillin G

Equipment List

* OPTIONS I and III ✻ OPTION II

TEM REF	Description of item.	OPTION	Capacity or size	Mat of const^n	No. off	Quoted yes	Quoted no	$ price
U1	Steam boiler 3bar saturated steam oil fired	*	10t/h	std	2			
U2	electrical transformers - substation	*	8MW	std	NA			
U3	solvent distillation unit	*	1ton/h	std	1			
U4	chilled water refrigerator (water 5°C)	*	3MW	"	NA			
U5	brine refrigerator (-30 °C brine)	all	2MW	"	NA			
U6	cooling towers + system 1700m³ water/h. 40-35°C		10MW	"	std			
U7	liquid nitrogen cooler	all	150kW	"	1			
U8	compressors 16Nm³/min x 10³ 2.5 bar	*	16000 Nm³/h	"	2			1,188,600
U9	waste water treatment plant 60m³/h.	*	60m³/h	"	1			
U10	standby diesel generators 2MW each.	*	MW	"	2			
✻U1alt	steam boiler 3 bar saturated oil fired	✻	2t/h	"	2			
✻U2 "	elec transformers substation	✻	1.5MW					
✻U4 "	chilled water refrigerator	✻	200kW					
✻U6 "	cooling towers	✻	2MW					
✻U9 "	waste water treatment not required							
✻U10	Stand by generators " "							

Priced SB 23/1

cc SB 22/1 OPTION 2

WR 8U n

MANDERSTAM I. CONSULTING ENGINEERS
2/10 HARBOUR YARD.
CHELSEA HARBOUR
LONDON SW10 0XD

Job No. | Page WP81
Made by | Rev.
Checked by | Date

PROJECT SPACE BUILDINGS & LAND 4SB 23/1

OPTION III . PENICILLIN & 6-APA ONLY

FACILITY	Type	BUILDING m²	BUILDING height M	TOTALS	LAND
Fermentation	1	1000	18		
Extraction	2	400	6		
6-APA	2	400	6		
pilot plant	3	100	6		
laboratory	3	300	4		
offices	3				
compressors	1	100	3		
solvent recovery	2	50	18		
warehousing	1	400	6		
		2750		3500	1 hectare 10,000 m²
utilities					
boilers	-	50			
cooling towers	-	400			
refrigeration	-	100			
waste treat	-	900		1800	
		1450			

notes

1) Steel framed, clad walls / roof, uninsulated, concrete floor, access doors for heavy equipment, steel framed supports for process vessels, standard electrical equipment

2) as 1 except explosion proof electrical equipment

3) 2 or 3 storey building, insulated, brick or clad construction, air conditioned, WC's, wash rooms, canteens, rest areas, steel framed

5.

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD. CHELSEA HARBOUR LONDON SW10 OXD	Job No.	Page WP 22
		Made by	Rev.
		Checked by	Date

PROJECT [illegible] SB 23/1

OPTION III CONTD.

		m^2	m^2	height
Fermentation hall	4 × 3.5m ϕ	15×15	= 225	18m
		15×15	= 225	18m
media make up		8×8	= 64	6m
additive " "		3×6	= 18	3m
control room		10×10	= 100	
seed fermenters	4 × 2m ϕ			
			732	

extraction + purification

15 modules 3×3 = + 10% 150 6m

Warehousing

raw materials excluding 20% sucrose, 50% potash, 33% ammonium [illegible], soy bean oil = [illegible] t/year
volume 6 months storage [illegible] = 23 [illegible] tons
or 1[illegible] × 200 litre drums occupy 100 m^2
space required [illegible] stacking 3 high with 30%
aisles 41 m^2 say 50 m^2 × 3m high

packaging 50% of above 25 m^2

finished goods 23 m^2

Total warehouse 20×20 = 400 m^2 × 6m high

SUMMARY OPTION III

Factory type buildings 3000 m^2
Laboratory offices 300
land 1 hectare

MANDERSTAM	CONSULTING ENGINEERS 2/10 HARBOUR YARD. CHELSEA HARBOUR LONDON SW10 0XD	Job No.	Page WP83
		Made by	Rev.
		Checked by	Date

PROJECT 4SB 23/1

OPTION I

option I = option III plus dosage plus semi synthetic

Facility	type	m^2	height	land m^2
Semi synthetic	1 (WP81)	300	6	
Dosage	3 (WP8)	300		
Total				

Amoxycillin & Ampicillin - same equipment.

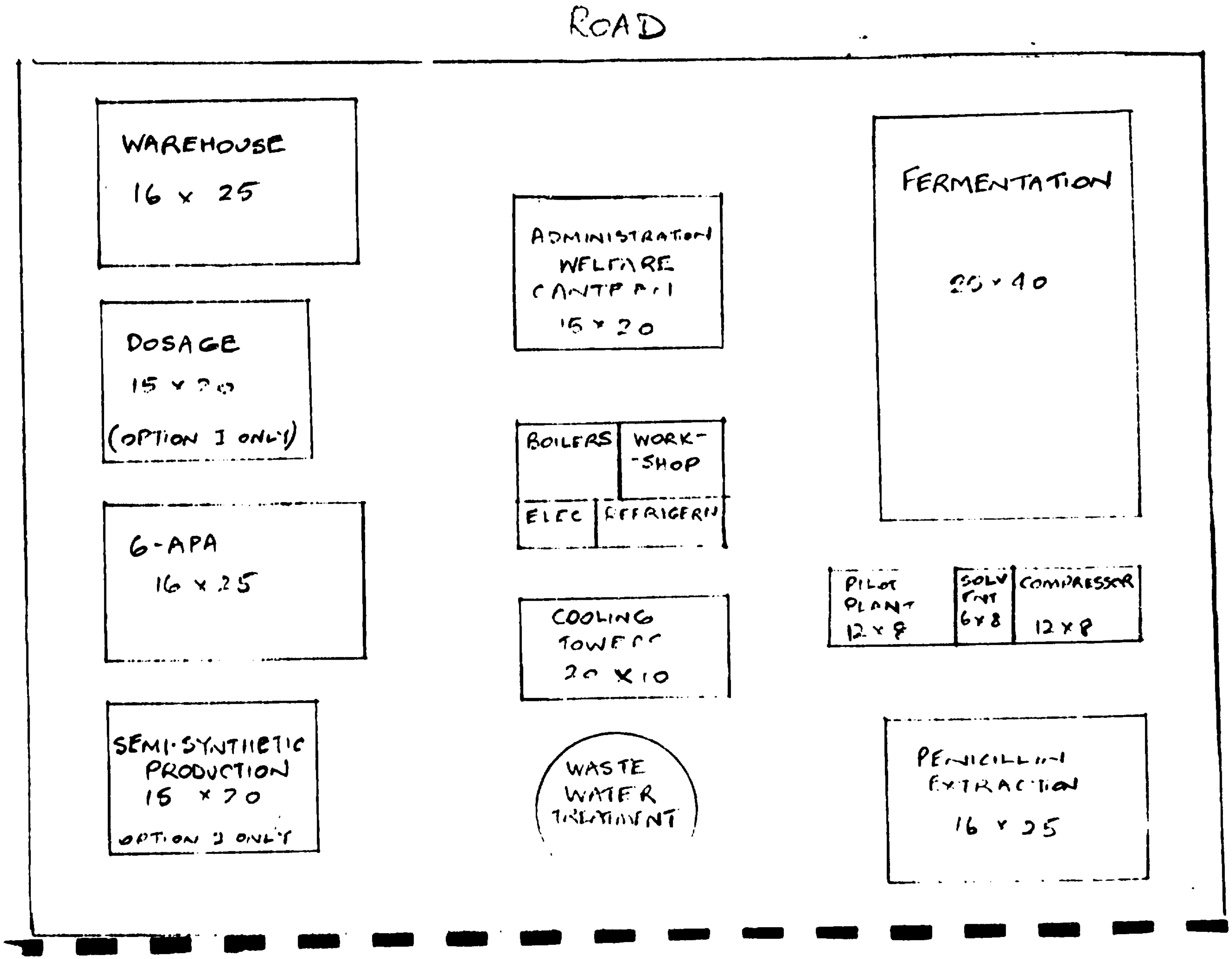
Dane salts (WP64A)	$50m^2$
Amoxy + ampi (WP 63)	$50m^2$
ancillary storage etc	200
total	$300m^2$ x 6m high

SUMMARY OPTION I

Factory type buildings	$3300m^2$
laboratory / office, type	$600m^2$
land 1 hectare	$10.000m^2$

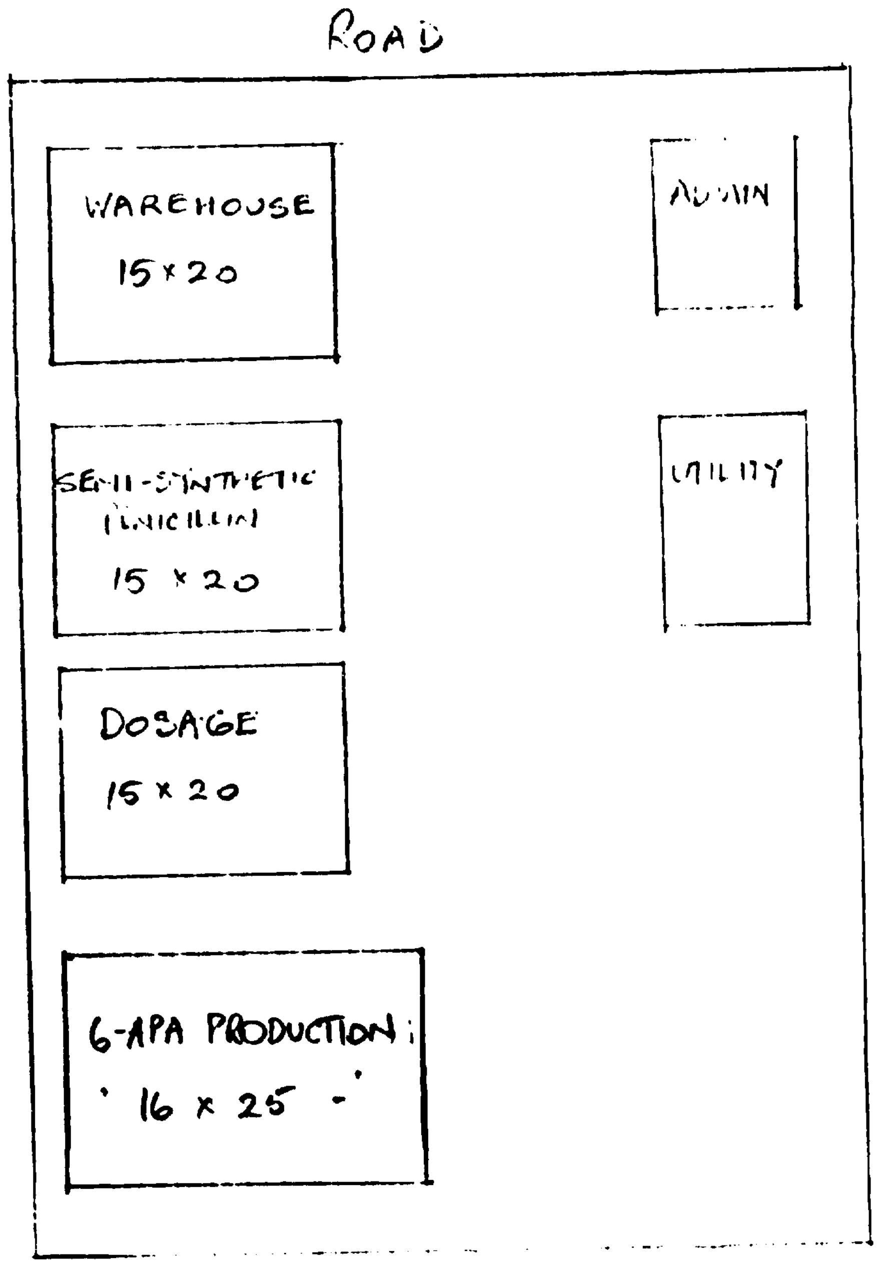
OPTION	I m^2	II m^2	III m^3
Factory type buildings	3075	1320	2850
Laboratory & offices	300	100	300
admin offices.	300	300	300
land	10.000		10,000

WP 84



TITLE: TYPICAL LAYOUT PROPOSALS – OPTIONS I and II
for ... SITE 115 x ??m
SCALE 1:500

73 JM



TITLE : TYPICAL LAYOUT
PROPOSALS - OPTION II
TO SUIT 5,000 m^2 SITE
85 x 60m
SCALE 1:500

WP 85