Table VII-1 PROJECT ECONOMIC RETURN (Case B)

								77.	Tree
						Present Value	aine	Fresent value	anne
			Economic Cost		Economic3)	(Discount Rate: 9%)	te: 9%)	(Discount Rate: 10%)	e: 10%)
	Year	A) Capital1)	B) Operat-2)	Total	Benefit	Economic	Economic	Economic	Economic
		Cost	ing Cost	(A) + (B)		Cost	Benefit	Cost	Benefit
	.00,	100 200		196 230		196 230		196,230	
	1981	150,230		261 640		240 036	14.25	237,854	
	1987	130,820		130,820		110,109		108,116	
	1984	65,410	69.582	134,992	113,575	104,238	87,700	101,421	85,330
	1085		88.493	88 493	169,999	62,691	120,432	60,442	116,111
	1086		93,612	93,612	190.790	60,841	124,000	58,126	118,465
	1000		93,612	93,612	192,521	55,818	114,794	52,841	108,672
	1088		93,612	93,612	192,521	51,209	105,315	48,038	98,794
	10%0		93.612	93,612	192,521	46,981	96,621	43,671	89,813
	1990		93.612	93,612	192,521	43,102	88,642	39,701	81,648
V	1001		93,612	93,612	192,521	39,543	81,323	36,091	74,225
′II	1993		93,612	93,612	192,521	36,277	74,608	32,810	67,477
-8	1003		93,612	93,612	192,521	33,282	68,447	29,828	61,343
	1904		93.612	93,612	192,521	30,534	62,796	27,116	55,766
	1995		93.612	93,612	192,521	28,013	57,612	24,651	50,697
	1906		93,612	93,612	192,521	25,700	52,855	22,410	46,088
	1007		93.612	03 612	192 521	23.578	48.490	20,373	41,898
	1998		93,612	93,612	192,521	21,631	44,486	18,520	38,088
	Total	654,100	1,375,031	2,029,131	2,784,516	1,209,813	1,228,121	1,158,239	1,134,415
I.					Benefit Cost	st: + 18,308	8	-23,824	
							l •		# §

Notes:

9+0.43 = 9.43% (E.I.R.R.)

See Attachment (1) to this table.
 See Attachment (2) to this table.
 Estimated at M\$ 420/t (US\$ 175 x 2.4) FOB for urea, and M\$ 492/t (US\$ 205 x 2.4) FOB for armmonia.

# Table VII-1 ATTACHMENT (1)

### ECONOMIC CAPITAL COST

Total Project Cost (Financial) excluding Interest during Construction

(000° \$2U)

	Foreign Exchange Cost	Local Currency Cost	Total
less: transferable cost*)	222,160	61,270	283,430
	4,580	1,310	5,890
			d <del>Markana</del>
Economic Capital Cost (US\$ '000)	217,580	59,960	277,540
	x 2.4		
Economic Capital Cost (M\$ '000)	522,190	131,910	654,100

Note: \*) Income tax to be paid by contractors' personnel

(a) The first series of the series of the

Table VII-1 ATTACHMENT (2)

### ESTIMATED ANNUAL OPERATING COST

			1984	1985	1986	Onwards
	(1)	Natural Gas (US\$'000)	10,410	14,151	15,854	15,854
	(2)	Utilities (US\$ '000)	2,607	3,556	3,992	3,992
/ Cost	(3)	Labour (US\$ '000)	4,083	4,900	4,900	4,900
urrency	(4)	Maintenance Cost (US\$ '000)	1,226	1,471	1,471	1,471
cal Cu	(5)	Overhead (US\$ '000)	6,805	8,166	8,166	8,166
(A) Local Currency Cost	(6)	Total L.C. Cost in US\$ (US\$ '000)	25,131	32,244	34,383	34,383
	4.5	F.E. Cost in M\$ x M\$ 2.2/US\$ (M\$ '000)	55,288	70,937	75,643	75,643
	(1)	Catalyst & Chemicals (US\$ '000)	1,053	1,432	1,604	1,604
Cost	(2)	Maintenance Cost (US\$ '000)	4,903	5,883	5,883	5,883
(B) Foreign Exchange Cost	(3)	Total F.E. Cost in US\$ (US\$ '000)	5,956	7,315	7,487	7,487
щ	E	l L.C. Cost in M\$ ) x M\$ 2.4/US\$ (M\$ '000)	14,294	17,556	17,969	17,969
Economi	c Cost (	A) + (B) (M\$ '000)	69,582	88,493	93,612	93,612

Notes:	(A)	1	Local	currency	cost

(1) Natural gas: US\$ 1.32/MMBTU (opportunity cost)
(2) Utilities: less 15% of the rates assumed for financial projections
(3) Labour cost: less 10% of the cost used for financial projection
(4) Maintenance cost: 20% of maintenance cost estimated for financial projections
(5) Overhead: As per cost estimated for financial projections

### (B) Foreign exchange cost

Catalyst & Chemicals: As per cost estimated for financial projections
 Maintenance cost: 80% of maintenance cost for financial projections

## Table VII-2 ESTIMATED STANDARD CONVERSION FACTOR & ESTIMATED SHADOW EXCHANGE RATE

	Year	p escribility	SCF*)	
:	1974		0.929	
	1975		0.931	
Teach	1976	Tribiga (bribin)	0.907	
er engage	1977	· Longition of the	0.908	
	1978		0.917	
		Average	e: 0.918	

Estimated Shadow Exchange Rate:

M\$ 2.2/US\$ ÷ 0.918 = M\$ 2.4/US\$

ing pand district morning minimum beginning

Note: \*) SCF computed by applying the following formula:

SCF = 
$$\frac{\text{IMP} + \text{EX}}{\text{IMP} (1 + \text{Taximp} + \text{TQimp}) + \text{EX} (1 - \text{Taxex})}$$

Here:

SCF = Standard Conversion Factor

IMP = Gross value of major imports (CIF price)

EX = Gross value of major exports (FOB price)

Taximp = Weighted average of import duty rates

TQimp = Import duty rates for tax varier

Taxex = Weighted average of export tax rates

For computation of SCF, the following figures were applied:

IMP: Refer to Table VII-2 ATTACHMENT.

EX: Refer to Table VII-2 ATTACHMENT.

Taximp: 30% (15% for import duty; 15% for surtax)

TQimp: Nil

Taxex: 10%

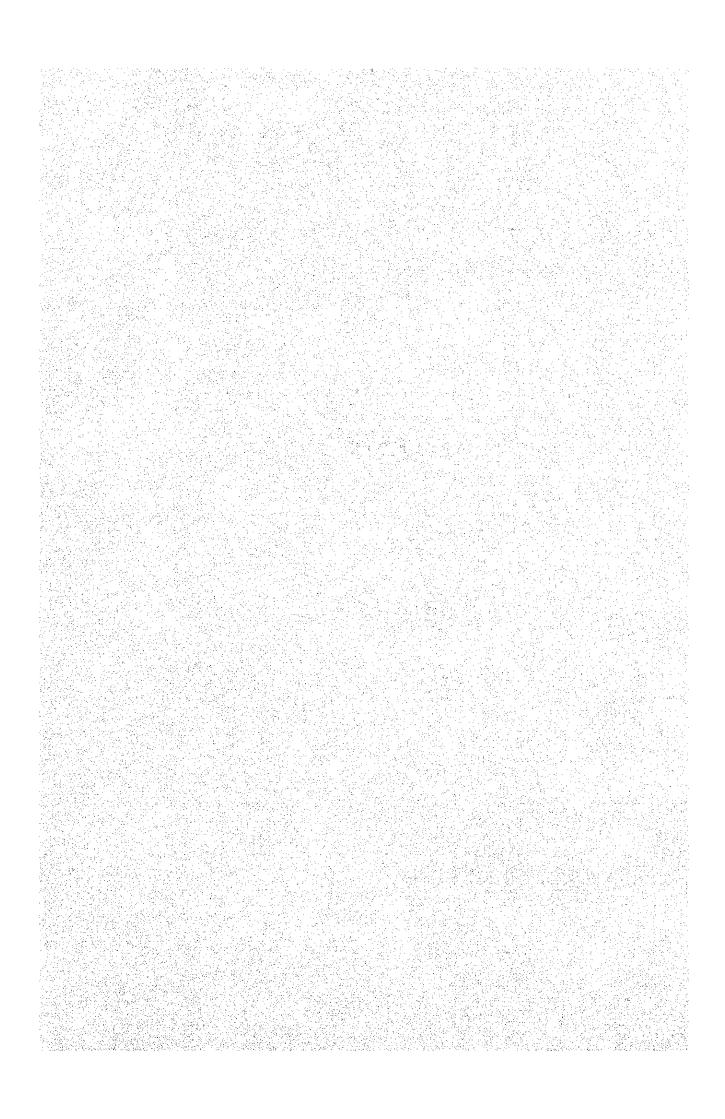
# Table VII-2 ATTACHMENT

# MAJOR EXPORTS/IMPORTS (Malaysia)

Year	Major Exports (M\$ millions)	Major Imports (M\$ millions)
1974	7,706.5	9,800.9
1975	6,512.9	8,463.6
1976	9,947.7	9,644.9
1977	11,254.4	11,083.9
1978	12,301.2	13,547.7

Source: Quarterly Economic Bulletin, March/June, 1979, Bank Negara Malaysia.

# APPENDIX I



### APPENDIX 1-1 MEMBERS LIST OF JAPANESE EVALUATION TEAM

THE SECTION OF THE STANSON

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charle that selled "New America Area "

# (1) Member of assigned experts

	Name	Function at Team	Title and Organization
Team	n Members		
1.	Dr. Shigeo UEKI	Team Leader	General Manager, Technical Department Japan Consulting Institute
<b>2.</b>	Mr. Masayasu SAKANASHI	Assistant Team Leader, Techno-Economist	Director, UNICO International Corporation
3.	Mr. Makoto KUWABARA	Project Engineer	Manager, UNICO International Corporation
4.	Mr. Katsuo ADACHI	Project Engineer	Consultant, Japan Consulting Institute
5.	Mr. Isamu MUTO	Civil Engineer	Manager, Japan Consulting Institute
6.	Mr. Ryoji KIKAWA	Civil Engineer	Manager, Japan Consulting Institute
7.	Mr. Shozo INAKAZU	Project Engineer	Manager, UNICO International Corporation
8.	Mr. Tetsuo INOOKA	Agricultural Economist	Manager, UNICO International Corporation
9.	Mr. Yukio TAKITA	Petroleum Engineer	Chief Engineer, Japan Oil Engineering Corporation
10.	Mr. Yoshio SATO	Project Engineer  — Logistics	Manager, UNICO International Corporation
11.	Mr. Kiyoshi YAMAGUCHI	Project Engineer	Japan Consulting Institute
(2)	Officers in charge of mini	stries or agencies conce	med
1.	Mr. Masahiro KUMAGAE		Ministry of International Trade and Industry
2.	Mr. Akihiro MITARAI		Japan International Cooperation Agency

			in the second se						
		Name : Sex 35 5 Vivi	Fund	ction at Tean	ու այր մ	itle and Organi	zation	94). ***	
-	3.	Mr. Norio FUKUBAYA	SHI	<del>~</del>		Japan Internatio	onal Cooperatio	on Agency	
	4.	Mr. Michio OHTA		<del></del>		The Overseas E	conomic Coope	ration Fund	
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### APPENDIX I-2 LIST OF COUNTERPARTS IN MALAYSIA

AFFENDIA 1-2 DIST OF COOP	
MANA SERVICE ASSESSED	spin Knidnes (184
Name Function at Project	Title and Organization
Administrative Member	den en tage of antique a security
1. En. Kamaruddin Nordin	Director, Industrial Division, Ministry of Trade and Industry, Malaysia
2. En. Mohamed Feisal Ibrahim	Deputy Director, Industrial Division, Ministry of Trade and Industry, Malaysia.
3. En. N. Sadasivan	Deputy Director General,  Malaysian Industrial Development Authority
4. En. Geh Sim Hong	Director, Planning & Research Division, Malaysian Industrial Development Authority
5. En. Sulbramaniam. P.	Economist, Malaysian Industrial Development Authority
6. En. Tan Chin Huat	Economist, Malaysian Industrial Development Authority
7. En. Salleh Amran	Deputy Under Secretary,  Ministry of Finance, Malaysia
8. En. Mustapha Bin Haron	Principal Assistant Secretary,  Ministry of Agriculture
9. En. Mohd. Som Bin Hj. Sulong	Managing Director, KPM NIAGA Sdn. Bhd.
10. En. Mohd Tahir Haji Ahmad	Marketing Director, KPM, NIAGA Sdn., Bhd.
11. En. Haji Harun Bin Mohd. — Avabee	Director, Development and Training,  Department of Agriculture
12. Ajit Singh	Deputy Director, Crop Production,  Department of Agriculture
13. Chin Kim Wah	Senior Agriculture Officer, Soil and Analytical Services, Department of Agriculture

		Mana	Function at Project	Title and Organization
		Name	1 unction at 1 toject	The and Olganization
	14.	Hashm Noor	<del>-</del>	Director of Research Services, MARDI
	15.	Rahim B. Rahuiat		Director of Development, Farmers Organization
. •		en e		Authority
	PET	RONAS (Petroliam Nasional Berh	ad)	
	1.	En. Tan Sri Abdullah Salleh		Chairman, PETRONAS
	2.	En. Rastam Hady		Managing Director, PETRONAS
	3.	En: Abdul Aziz Ahmad	Chairman	Executive Director, Processing & Manufacturing
	2	(Succeeded by En. M. B. Hashim)		Department, PETRONAS
٠		En. Ismail hashim	i di <u>.</u> Barangan	Executive Director, Finance Department, PETRONAS
	5.	En. Adnan Abdul Wahab	Leader	Manager, Fertilizer Project Department,
				PETRONAS
	6.	En. Mohd. Shukor Owar	Leader	Manager, Project Planning & Monitoring Department, PETRONAS
	7.	En. Tan Hai Leng	Coordinator Technical Team	Processing & Manufacturing Department, PETRONAS
	8.	En. Hasno Zakaria	Technical Team	Processing & Manufacturing Department, PETRONAS
	9.	En. Wan Fauzi Tuanku Esim	Technical Team	Processing & Manufacturing Department, PETRONAS
	10.	En. Abdul Ghani Muda	Technical Team	Processing & Manufacturing Department, PETRONAS
٠				PETRUNAS
	11.	Dr. Mohd Ayob	Gas Team	Exploration and Production Department, PETRONAS
	12.		Gas Team	Processing and Manufacturing Department PETRONAS
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	Name	Function at Project	Title and Organization
13.	En. Ramanathan Krishna Iyer	Gas Team	Processing and Manufacturing Department, PETRONAS
14.	En. Hilmi Mohd. Nashir	Finance and Economic Team	Processing and Manufacturing Department, PETRONAS
15.	En. Juarez Rizal Abd. Hamid	Finance and Economic Team	Processing and Manufacturing Department, PETRONAS
16.	En. Abd. Ghani Arip	Finance and Economic Team	Finance Department, PETRONAS
17.	En. Bahari Kamar Shah	Market Team	Processing and Manufacturing Department, PETRONAS
18.	En. Awang Othman Awang Jaya	Marketing Team	Marketing Department, PETRONAS
19.	En. Mohd. Johari Ismail	Marketing Team	Marketing Department, PETRONAS
20.	En. D.M. Anwar Raja	Petroleum Engineer	Production Department, PETRONAS
21.	Ms. Siti Shamsiah Shaari	Marketing Team	Finance Division, PETRONAS
22.	En. Masri Yusoff	Coordinator	Area Manager, PETRONAS, Miri, Sarawak
23.	En. Ishak Bin Nordin	Coordinator	PETRONAS, Miri, Sarawak
24.	En. Wan Idris Yacob	Coordinator	PETRONAS, Miri, Sarawak
25.	Mr. Kohji Tanaka	Consultant The state of the sta	Project Director, C. Itoh Technical Consultants, Inc., Japan
26.	Mr. Hiroshi Ikemoto	Consultant	Project Manager, Mitsubishi Heavy Industries, Ltd., Japan

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e. Pengerak dan digunakan dan erebagian dan

# APPENDIX I-3 LIST OF ORGANIZATIONS VISITED AND PERSONS MET BY THE TEAM

(1) List of organizations visited

\*\*\*

- Ministry of Finance, Malaysia
- Ministry of Trade and Industry, Malaysia
- Ministry of Agriculture, Malaysia

\*\*\*

- Embassy of Japan
- Japan International Cooperation Agency, Kuala Lumpur, Malaysia

\*\*\*

- PETRONAS (Petroliam Nasional Berhad)
- Malaysia LNG Sdn. Berhad

\*\*\*

- Malaysian Industrial Development Authority
- Federal Land Development Authority
- Rubber Research Institute of Malaysia
- Rubber Industry Smallholders Development Authority
- Malaysian Agricultural Research and Development Authority

\*\*\*

- Geological Survey Department, Kuala Lumpur
- Meteorological Department, Kuala Lumpur
- Telecommunications Department, Kuching, Sarawak
- Drainage and Irrigation Department, Kuala Lumpur

- Department of Agriculture, Kota Kinabalu, Sabah and Agriculture
- Padi Board, Kota Kinabalu, Sabah

\*\*\*

- Bintulu Development Authority, Kuching, Sarawak
- Bintulu Developmelnt Authority, Bintulu, Sarawak
- Sarawak Electricity Supply Corporation, Kuching, Sarawak
- Sarawak Electricity Supply Corporation, Bintulu, Sarawak
- Public Works Department, Kuching, Sarawak
- Public Works Department, Bintulu, Sarawak
- Sarawak Land Development Board, Kuching, Sarawak
- Muda Agricultural Development Authority, Kedah
- Kuching Port Authority, Kuching, Sarawak
- Penang Port Committee, Penang

\*\*\*

- Chemical Company of Malaysia
- Esso Malaysia Berhad
- Federal Fertilizer Company
- ICI (Malaysia) Sdn. Bhd.
- Ajinomoto (Malaysia) Berhad
- Daiya Malaysia Sdn. Bhd.
- Wee & Wee Fertilizers and Chemicals Sdn. Bhd, Kuching, Sarawak
- Trans-Asia Shipping Corp. Penang
- Guthrie Kimia Sdn. Bhd. Butterworth
- Perdagangan Perkasa Sdn. Bhd., Kota Kinabalu, Sabah
- Rira Corporation Sdn. Bhd., Penang

\*\*\*

- Stanley Consultant, Kuala Lumpur
- Halcrow Balfour Ltd., Kuching, Sarawak
- Teamwork, Malaysia Sdn. Bhd.

		T	Title and Organization
	Name	Function at Team	Title and Organization
Bintı	ulu Development Authority, BD	A (Lembaga Kemajuan B	sintulu)
1.	En. Yb Datuk Jamaludin		General Manager, Bintulu Development Authority, Kuching, Sarawak
2.	En. Abang Helmi Datuk Amar Ikhwan	Maria Haraba Tabupatèn Ja	Secretary, Bintulu Development Authorit Kuching, Sarawak
3.	En. Mohidin Ishak	and the second s	Bintulu Development Authority, Bintulu, Sarawak
	, W 1 D	r n rrn	Same for the Control
Publ	ic Works Department, PWD (Jal	ратап Кепа Кауа, ЛКК)	The section of the first pro-
1.	En. Michael K. N. Ting		Assistant Director, Public Works Department Kuching, Sarawak
2.	En. Stephen Kong Swee Meng	<del>.</del>	PWD, Land & Survey Dept., Kuching
3.	En. Victor Vone	<del>-</del>	PWD, Road Branch, Kuching
4.	En. Timothy Liaw Aik Hon	· · · · · · · · · · · · · · · · · · ·	Public Works Department, Kuching, Saraw
5.	En. Ting Kong Siin		Engineer, Public Works Department, Kuchin Sarawak
6.	Mr. Andrew Macoun	kundig be <u>k</u> ardi buat Prope	Advisor, Public Work Department, Kuchin Sarawak
7.	En. Kong Bun Him	ojo od Pograda Ograda Valorija	Public Works Department, Bintulu, Saraw
8.	En. Lim Chin Aun		Public Works Department, Bintulu, Saraw
Sara	wak Electricity Supply Corpora	ition, SESCO (Perbadana	n Pembekalan Letrik Sarawak)
1.	En. Roger Wong		Sarawak Electricity Supply Corporation
2.	En. Yao Sik Heng		Professional Engineer (M), Sarawak Electric Supply Corporation, Bintulu, Sarawak

	Name	Function at Team	Title and Organization
Toloo	ommunications Department, T	TELECOMS (Johotan Tale	ston TELEKOM)
i elec	ommunications Department, 1	ELECOMS (Javatan 1616	SKOIR, I BLENOW)
1.	En. Gordon Kong		Engineer TELECOMS
2.	En. Chen Eng Kiat	<u> </u>	SEA, TELECOMS
Kuch	ing Port Authority (Lembaga l	Palahuhan Kuching)	
Kucii	ing Fort Authority (Lembaga 1	Claudian Ruching)	
1.	En. Duke Shim	<u> </u>	Assistant Manager, Kuching Port Authority, Kuching, Sarawak
			Kucimig, Sarawak
2.	En. Kho Chin Kay	— ·	Traffic Manager, Kuching Port Authority,
			Kuching, Sarawak
Fssn	Malaysia Berhad, Port Dicksor	1	
	malaysia Domina, 1 Ort Diemoor	•	
1.	Mr. C. A. Rose	<del>-</del>	Managing Director, Esso Malaysia Berhad
2.	En. A. C. Mah	<u></u>	Acting Refinery Manager, Esso Malaysia Berhad
3.	En. Y. S. Lee		Technical Manager, Esso Malaysia Berhad
4.	En. R. Tharmarajah	·. –	Chemical/Project Manager, Esso Malaysia
			Berhad
5.	En. H. S. Ho		Operations Superintendent
		anasa Walawa Labas Sa	
Chen	nical Company of Malaysia, IC	I (Malaysia) Sdn. Bhd., K	uala Lumpur
1.	En. S. S. Sidhu	<del>-</del> -	Assistant Works Manager, CCM
2	En. Mok Kum Ming		Managing Officer, ICI
2.	En. MOK Kum Milig	<del>-</del>	managing Officer, ICI
3.	En. Koh Ting Tien		Operations Department Manager, CCM
Halc	row Balfour Ltd., Kuching, Sa	rawak	
1.	Mr. Michael W. Crabb	<del>-</del> -	Chartered Engineer

Name Function at	Team Title and Organization
Malaysian Industrial Development Authority, Kuch	ung, Sarawak
1. En. Mansor B. Abdullah	Regional Director
Geological Survey Department, Kuching, Sarawak	
1. En, Kho Chin Heng -	Kuching Office
Meteorological Department, Kuala Lumpur	
1. En. Mohamad —	Hydrologist

APPENDIX I-4 STUDY SCHEDULE OF JAPANESE EVALUATION TEAM

JAPANESE TEAM MEMBER

								Yearly	Teleita	Cos	Vamomichi	Kumaose	Ohta	Mitatai	Fukubayashi	. 1
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E	BTL/KG		BTL/KG	BTL/KG	BTL/KG	BTL/KG	BTL/KG	KBU/KL	KL	BTL/KL	BTL/KG	•	KL/TKY	•	BTL/KG	
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Abbreviation; TKY; Tokyo KL; Kuala Lumpur KG; Kuching KBU; Kota Kinabalu BTL; Bintulu PNG; Penang MNL; Manila

October, 1979

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### APPENDIX I-5 LIST OF DATA, DOCUMENTS AND DRAWINGS RECEIVED

### (1) Project Status

1) FINAL REPORT OF THE PART "B" OF THE DOWNSTREAM STUDY OF THE MASTER PLAN STUDY FOR THE DEVELOPMENT OF PETROLEUM RESOURCES IN MALAYSIA, VOLUME 1, 2, 3, 4 — DECEMBER, 1979. — PREPARED FOR PETRONAS BY C. ITOH & CO., LTD.

(The Japanese Evaluation Team was allowed to review the documents during the study period in Malaysia and the documents were returned to PETRONAS).

2) INTRODUCTORY BRIEF ON THE ASEAN UREA PROJECT (MALAYSIA) — PETROLIAM NASIONAL BERHAD — PETRONAS

### (2) Natural Gas Supply

- 1) Migrated Depth Contour Map, E11, F23, F6, E8, F13
- 2) Cross Section and Reservoir Quality, E11, F23, F6, E8, F13
- 3) Well Logs and Lithological Interpretation of Carbonate Section, E11, F23, F6, E8, F13
- 4) Central Luconia Reserve Parameters Mean Values
- 5) Central Luconia Reserves
- 6) Reserve Estimating Procedure
- 7) Field Location Map with the Names of Fields to be Designated to MLNG and Urea Projects
- 8) Offshore Installations and Production Facilities, Central Luconia

- 9) MLNG Upstream Project Development Schedule
- 10) Proposed Central Luconia Completion Design
- 11) Central Luconia, No. of Wells per Field And Alexander
- 12) Process Flow Sheet, Typical Field Facilities (offshore), Commingled Production
- 13) Tentative Plan Bintulu Industrial Area, Sarawak
- 14) Production Scheme Central Luconia Gas Supply to MLNG
- 15) Combined Peak Production Capacity vs Time
- 16) MLNG, into Plant Feed Gas Composition/Natural Gas Supply Schedule/Production Profile
- 17) Gas Composition of Central Luconia Fields
- 18) E11.3 Reservoir Parameters after Acidization
- 19) Summary of Production Test Results, F23.2
- 20) Gas Well Test Results, F6.5, F6.4
- 21) F6.4 Results of Production Tests
- 22) Gas Well Test Results, E8.4, E8.2
- 23) Analysis of BHP Survey, F13.3
- 24) F13.3 Back Pressure Curve after Acidization
- 3) Site Selection, Utility Supply and Infrastructure
  - 1) Topographical Map, Proposed Site Area 1/2,500

- 2) Ammonia Urea Project Water Supply System Map 1/5,000
- 3) MLNG Overall Layout
- 4) Bintulu Deepwater Port Site Location Plan
- 5) Structure Plan for Bintulu Region
- 6) Mineral Resources Map of Sarawak
- 7) The Geology & Mineral Resources of the Suri-Baram, North-Sarawak
- 8) Miri/Bintulu Regional Planning Study Supplementary Report # 1, 1974
- 9) The Port Authority Ordinance 1961, Kuching
- 10) Meteorological Data

### APPENDIX I-6 ASEAN UREA PROJECT (MALAYSIA)

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### 6-1: Project History and a many majority of Haras and her many water bear

(1) The ASEAN Economic Ministers at their Second Meeting in Kuala Lumpur on March 1976 decided that Indonesia and Malaysia shall each be allocated a urea project, provided that each ASEAN member state is satisfied with the viability of the project.

the problem things to design by the particular temperature of the other as

- (2) PETRONAS engaged the firm of C. ITOH & CO. of Japan as its consultant for purpose of preparing a feasibility study. The report was completed in December 1977 with the conclusion that the setting up of 1,300 MTPD Ammonia Plant and 1,500 MTPD Urea Plant will be most viable.
- (3) The Sixth Meeting of the ASEAN Economic Ministers (Jakarta, 5 7 June 1978) that the proposed capacity of the Ammonia Plant of the ASEAN Urea Project (Malaysia) should be revised downwards from 1,300 MTPD to 1,000 MTPD whilst that of Urea Plant still be at 1,500 MTPD.
- (4) Upon detailed evaluation of the Project by the ASEAN member states, wherein certain changes were made to the project scope, the ASEAN Economic Ministers at its Seventh Meeting convened at Kuala Lumpur on 14 16 December 1978 agreed that the ASEAN Urea Project (Malaysia) is viable and accepted it as an ASEAN Industrial Project.

### 6-2 Current Status

PETRONAS as the implementing agency for the ASEAN Urea Project (Malaysia) proceeded with the following major activities:

- (1) Formulaiton of the Joint Venture Agreement and the Articles and Memorandum of Association for the Company. The First Meeting of the Shareholder Entities was held at Kuala Lumpur on 17 19 July 1979.
- (2) Selection of Technical Consultant to undertake the process selection, formulation

of the project specifications and bid package for the main contract, detail project costing, procurement and construction supervision and commissioning and start-up.

- (3) Land acquisition, soil and subsoil investigation and site preparation. PETRONAS has engaged Jurutera Konsultant to do preliminary soil investigation.
- (4) Formulation of the detail marketing and distribution plan for Urea and Ammonia in Malaysia.

# APPENDIX I-7 PAPER ON PETRONAS STRATEGY AND ACTION PROGRAMS FOR DOMESTIC MARKETING OF UREA

19th October, 1979

By: Fertilizer Dept. P & M Division

ราก (ค. ระกาศการณาสัย โดยโดยพ.)

### PREAMBLE

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Japan International Cooperation Agency (JICA) has been appointed to review and evaluate the feasibility of the ASEAN Urea Project. With this objective, JICA's Evaluation Team visited Malaysia from 2/9/1979 to 26/9/1979. On September 23, the Team presented an Interim Report containing a summary of Team's findings or observation in respect of the basis of the Project as well as major elements to be confirmed as a basis for its subsequent evaluation studies to be performed in Japan.

In the letter accompanying the report, JICA has requested PETRONAS to submit a paper stating a strategy and action programme contemplated for the marketing of ammonia/ urea as well as its present position for inclusion in their report to pertinent authorities in Japan.

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### MARKETING STRATEGY AND ACTION PROGRAMME CONTEMPLATED FOR THE MARKETING OF AMMONIA & UREA PRODUCED BY ASEAN UREA PROJECT IN MALAYSIA

### 1. Objective

The objective of this paper is to outline briefly the strategy and action programmes contemplated for marketing of ammonia and urea produced by ASEAN Urea Project in Malaysia as well as a description of the present marketing position.

### 2. Introduction

The agricultural sector is at present the largest sector of the Malaysian economy. In 1975, it contributed 29.8% of the GNP and provided employment of 49.5% of the Malaysian total labour force. It is also estimated that 69% of all poor households are found in this sector. In recent years, agricultural development has been substantial and will continue to increase as a result of Government direct role in order to attain the objectives of the New Economic Policy.

However, productivity in agricultural sector is still relatively low. Among Government measures to increase output are its modernization programmes, research programmes, improved drainage and irrigation system, expansion of replanting scheme, crop diversification programme, improved training and extension services, revamping credit and subsidies scheme and improved agricultural products marketing system. These will greatly contribute to the improvement of agricultural sector.

A stable supply of fertilizers at reasonable price to the agricultural sector as well as implementation of socio-economic measures to encourage the use of fertilizers is regarded as the key to increase output and development of this sector.

### 3. Strategy and Action Programme for Marketing & Distribution of Ammonia and Urea

### 3-1 Current Fertilizer Distribution Network

Minister Arthur Harris Burgaria, America Graficato de la Propie de Prof

On the whole, Malaysia is heavily dependent on imports of her fertilizer requirements from a large number of countries, but four countries, Christmas Island,

Germany, Canada and Japan, supply two-thirds of Malaysian fertilizer imports.

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The import trade is handled by six major importers who also organize the wholesale and retail business. These commercial importers have their own fertilizer advisory services to assist in the marketing of the product. They work closely with Government research and extension agencies. Sales of these fertilizers by the importing firms are sometimes direct to the larger consumers such as estates and Government Agencies or through dealers.

In addition to these private dealers, farmers cooperatives, replanting agencies, and land development boards play an important part in the distribution of fertilizers to small farmers.

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In normal times, the imports and distribution of fertilizers are 'free' and left to the private sectors for Malaysia which has a well developed import and distribution system run by experienced wholesalers and retailers.

The Government itself through the Ministry of Agriculture plays an important part in making fertilizers available to small farmers. Apart from organizing supplies of fertilizers to the farmers, the Government's role in fertilizer distribution includes:

- a) organizing institutional credit to small farmers;
- b) increasing fertilizer retail outlets at the farm level through the establishment of farmers cooperatives and small agricultural units;

- c) providing fertilizers, subsidy schemes and other agricultural inputs, as a package programme so as to promote agricultural diversification and increase the productivity of small farmers;
- d) Undertaking research to improve fertilizer-use by small farmers and other agricultural production units.

### 3-2 Basic ASEAN Urea Production & Marketing Arrangement

At present fertilizer manufacturing in Malaysia is limited to Ammonium Sulphate, Ammonium Nitrate and Compound Fertilizers. Demand for Urea is met entirely

by import. The ASEAN Urea Plant (the Project) in Bintulu with the capacity of 1,000 MTPD liquid ammonia and 1,500 MTPD prilled bulk urea is expected to commence commercial operation by January, 1984. PETRONAS was appointed as the execution agency for the project.

As agreed by ASEAN shareholders the plant shall in the first place supply the total Malaysian domestic market and thereafter share equally with the Indonesian ASEAN Project the available ASEAN Market. The Joint Venture Company for the project will sell urea on Free on Board (FOB) basis to these markets and it has been agreed that the FOB price will be set at world prices in the range of the floor and ceiling price set with the maximum and minimum project rate of return. Offtaking of urea will be arranged in accordance with preferential Trading Arrangement among ASEAN member states.

The production policy of the plant will be to adjust its production in order to meet with the Malaysian and ASEAN demand patterns in the initial years. Should there be any surplus production, then Malaysia will guarantee to absorb them. From the Malaysian and ASEAN demand projection, it is observed that the Malaysian demand is increasing at a steady rate. With the production limited to the plant capacity of 1,500 MTPD, urea available for the ASEAN market allocated for the Project will gradually decrease. Hence there will be no surplus after the 6th year of production and the sales after this period outside ASEAN will be very unlikely.

### 3-3 PETRONAS Marketing Strategy and Action Programmes

As the plant will be on stream by 1984, PETRONAS is aware of the fact that the marketing activities should be implemented well in advance of this date in order to prepare for the marketing of the products.

In full recognition of the above, PETRONAS has already decided on the organization and development of domestic marketing systems so that the marketing and distribution system will be well organized and ready for operation at the time of commencement of commercial production of the project.

### 3-3-1 Basic policy and strategy

Based on preliminary analysis of data and information, basic marketing and distribution strategy and policy has been formulated.

For the purpose of marketing and selling the products for the domestic market, a Marketing Company will be formed which will be 100% Malaysian-owned. This Company will have bagging facilities in Bintulu for bagging of bulk urea.

The basic policy of the Company is to utilize the existing domestic distributors of fertilizers as its agents. A domestic distribution scheme (refer to Chart I) has been developed by PETRONAS for the Company to consider for adoption.

A State of the State

In the proposed scheme, the bagged urea will be shipped and delivered by the Company using third party shipping to the major ports in the country. In Sabah bagged urea will be shipped by coastal vessels to Kota Kinabalu, Sandakan and Tawau. In Sarawak, the ports of entry will be Miri and Kuching (urea can be sold ex-works in Bintulu itself). For Peninsular Malaysia it will be Port Kelang, Pasir Gudang, Kuantan and Butterworth. Bagged urea will be distributed to appointed agents at the above ports on CIF basis.

This Company is to have appointed agents in Peninsular Malaysia, Sabah and Sarawak to distribute the urea to dealers, for the following reasons:

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- i) Distribution of urea to the farmers, farmers cooperatives and dealers will be done by people experienced in the field and using established marketing channels.
- ii) The Company will not have to invest in warehousing and transportation facilities. The appointed agents will have their own established warehousing facilities and transportation network. There will not be any deprivation of income or unnecessary duplication of facilities.

It is envisaged that the basic strategy and policy will ensure that the Malaysian agricultural sector will have a stable supply of urea at reasonable and stable prices and support of the effort of experienced fertilizer distributing agents such as FELDA\*1), FELCRA\*2), RISDA\*3), MADA\*4), and Farmers Organization. These agencies provide an important contract with the farmers.

### 3-3-2 Action programmes

To facilitate the planning and execution of the domestic marketing and distribution systems, PETRONAS intends to take the following action:

1) Appointment of Marketing Consultant

PETRONAS is in the process of appointing a Marketing Consultant of international repute with extensive experience and knowledge in the field of marketing and distribution of fertilizers to perform among others the following:

- i) Re-examination of the foregoing basic policy, strategy and scheme, so as to establish an optimal and sound marketing and distribution plan. Such plans would include a plan for sound and efficient transportation and distribution facilities and systems, taking into account of the strength and the weaknesses of existing distributors as well as the capability and capacity of their facilities;
- ii) Organization and manning requirement of the new Marketing Company;
- iii) Formulation of a comprehensive training programme for key personnel contemplated to take up various responsible positions in the marketing and distribution operation;
- iv) The formulation of a comprehensive plan for promotional and extension programmes and services with a view to encourage and educate farmers to use urea as well as to introduce and promote its application in other sectors as substitutes for other nitrogenous fertilizers;
- v) Financial and financing requirement of marketing and distribution efforts.

### 2) Establishment of a Marketing Task Force

A Marketing Task Force has been established in PETRONAS to initiate the planning and implementation of the marketing programmes and activities prior to the incorporation of the Company.

In this connection, the Task Force have conducted and completed data and information collection supported by field survey, state by state within Malaysia. Based on the findings of this study a preliminary marketing and distribution plans have been developed.

An initial batch of three key marketing personnel have been sent abroad for training on marketing and distribution of fertilizers and have completed the programme. Meanwhile the Marketing Task Force are finalizing plans to send more personnel for training in various aspects of fertilizer marketing and distribution.

Among other activities, to be performed by the Marketing Task Force includes:

- i) Meetings and discussions with various Government Agencies with the view to assess and develop governmental programmes and practices relating to:
  - a) expansion of subsidy schemes in a long term
  - b) further enhancement of extension services
  - c) research by governmental institutes for application of urea
- ii) Formulating and implementing the premarketing programmes to ensure that the marketing personnel are familiar with the practical aspects of the marketing and distribution of urea in Malaysia.

<sup>(</sup>Notes) \*1) FELDA - Federal Land Development Authority

- \*2) FELCRA Federal Land Consolidation and Rehabilitation Authority
- \*3) RISDA Rubber Industry Smallholders Development Authority
- \*4) MADA Muda Agricultural Development Authority

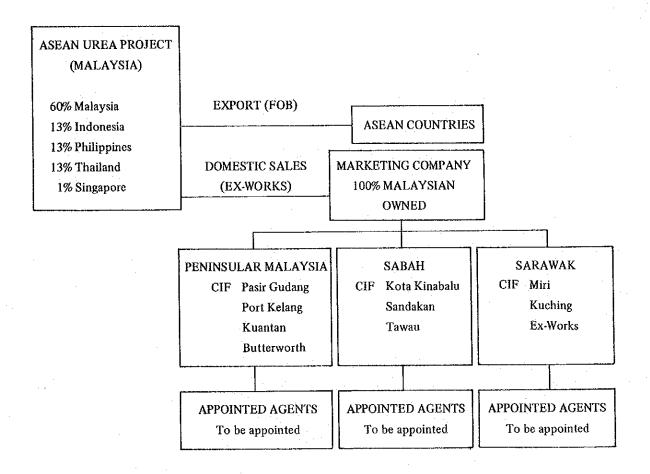
24/10/79

Fertilizer Dept.

Processing & Manufacturing Div.

### UREA DISTRIBUTION PATTERN

### A PROPOSAL



# APPENDIX II

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그런 사람이 있는 회사 이번에 가장 하는 이 사람이 사람이 되었다. 이 그 이번 경기를 가장 하는 이와 회사하는
나는 말한다는 이상에 나오면 하는 사람이 되고 있다. 동네는 아니라 사람들은 한 사람이 없었다.
이 이렇게 되는 이 말이 하는데 하는데 전환 기존에 다른 바람이 모든 사용을 보고 하는데 보다.
그리다 마음이 하장 노인하고 한 이름을 모하고 하는 것으로 말았다면 해. 전쟁 만든 사람들이 모나 들었다.
그는 보는 집 집 나는 그들도 본 사람들을 위하다 살다는 말이 보면 하는 말을 하다 했다. 나는
이어는 살 보는 하면 하는데 보다 이렇게 하는데 그들을 살아가는 바다 되었다.
그 희생은 호텔 전 그는 그들이 그 모든 사람들이 한 경우를 보고 있다면 하는 것 같습니다.
그들은 바는 그림은 일반하고 있었다. 아름일은 이는 말을 다른 말을 하고 있다. 작년 생각이 없다.
- [발발]
그림을 시간하는 이번 그렇게 그림으로 살으면서 그는 그 그리다고 먹고는 속이 없을 보다.
그렇게 됐다는 하는 것은 일반에 되어 가장되지 않는데 이 그리고 하는데 감사되었다. 회
그러지는 회장인 사용을 하다고 하는 사람들이 내려가 하는 사람이 되는 사람들은 사람들은 것이다.
그들이 병화를 하는 말이 아무리는 이번만 그녀는 것 같아. 아이지를 살아 내가 나가는 말이 나갔다.
그리즘의 경기 밝힌 눈이를 가고 있다면 되었다는 것이다는 하는 것이 그렇게 되었다. 나는 사람들이 되었다.
어린 하다 들고 있는 소요님은 어떻게 하고 있는 사람들은 얼굴한다고, 그 아무는 그는 것도 말했다.
그리는 학생 유민이들도 살이 많아 들었다. 얼마 학생들은 그리는 학생들은 그 그리는 사람들이 작업이었다.
이번 이렇게 하지만 함께 하는 것이 있었다. 그리고 하는 그리고 하는 그를 가는 그는 그는
어릴 수 없는데 이 이렇게 되었다. 그는 사람들이 나는 그는 그는 사람들이 되었다고 있다. 그리다
인정보다는 그는 이번을 들었다. 그렇게 이번 사이에 가지 않는데 하는데 하는데 하는데 하는데 없다.
그들이 맞아들어 들어들은 아이들의 하는 아이들이 얼마를 살아 먹었다. 그는 사람이 되어 모든 것이다.
그 회생들 회소식에 하는 본 하세요 나쁜 눈이는 회학하실 하는 경찰 경에 살아온 돌리는 목표를 하는다.
그램, 그렇게 하는 그리는 얼마나 뭐 하는 것 같아. 그리는 것이 되었다는데 하는 것이다.
- 발스토램트리트및 이 되는 토토도를 하고 그는 말이 되는 이 보는 그는 것이다. 그 그 이 아니
그는 그를 하는 맛이 그렇게 그렇게 하는 경험이 되는 이고 있어 못 하다고 있어 먹는 것 같아요.
공통교회로 회의 원칙에 대한 모든 사람들은 보고 있다. 그는 전환 사람은 그는 사람은 그는 모든 것이다.
그렇게 맞게 되는 아이들은 아이들은 아이들은 그는 그들은 사람이 되었다. 그런 나는 사람이 되는
그리는 얼마나는 그들도 하는 말이 보고 있을 때로 가는 그는 것으로 본 살은 아니라 그는 돈을 했다.
- 전화, 프랑크, 프랑크, 프랑크, 프로그, 프랑크, 프로그, 프로그, 프랑크, 프랑크, 프랑크, 프랑크,
그런 사용한 사용성과 경기에 가는 역상된 경상된 그 사용 그는 이 그리고 하면 가입니다. 작가는
그래요일 중요일 한 일본 이 노고 화장 원생이다. 하는 것 않는 것 않는 그는 것입니다. 하는 하는 하는 이 모양이 살린다.
- 하루 방송화 하다 한번으로 살아가는 모든 하는 사람들이 되는 것은 그를 모든 것이 되었다.
그릇한 이렇게 되는 하는 가는 그들도 얼마나는 이렇게 얼마를 받는 것이 없다.
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- 현실물을 하고 하는 얼굴님 농소는데 얼굴로 가는 물건 네트리스 모음을 하는 것이다는 얼굴 되는 그렇게 하다.
그렇지만 동생들은 한 경기에 가를 보면 해를 받을 때문에 되었습니다. 그는 사람들이 되었는 사람이 다른
- 교육적 화물시간는 "살림시는 "보고 불고하다면 시작되고 하지고 "로그램 보고 된 기가 되고 있다".
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### APPENDIX II-1 PROJECTION OF DEMAND FOR AMMONIA AND UREA

### 1-1 Method of Projecting Demand

### 1-1-1 Demand projection of nitrogen fertilizer

- (1) Projection of demand was made by crop. Some crops are subdivided into groups, in case the crops are major fertilizer-consuming crops, and the dosage is likely to vary considerably from group to group to such an extent that if the demand projection is made on the crop as a single group, a higher error is likely. The criteria for this subdivision was as follows:
  - 1) Irrigated area and rainfed area
  - 2) Participation and non-participation in land development or other agricultural schemes
  - 3) Estate and smallholder farms
  - 4) Main and off-season crops
  - 5) Mature tree and immature tree
  - 6) High-yielding varieties and conventional varieties
- (2) The future levels of demand were projected for each crop or group, using the following formula:

(Future demand value) = (Cropped area) x (Ratio of fertilized area) x (Dosage per hectare)

For those crops for which it is difficult to estimate the ratio of fertilized area, the following formula was used:

(Future demand value) = (Cropped area) x (Average dosage per hectare of cropped area)

- (3) As the first stage of making the projections, the historical ratio of fertilized area, and the dosage per hectare, were estimated. In making these estimations, the following data and study results were utilized:
  - 1) Historical data on fertilizer use by crop group or by crop
  - 2) Field information regarding fertilized area and dosages actually applied
  - 3) Recommended dosage for each crop
- (4) Using the historical data on fertilized areas, estimates of dosage per hectare, and historical data on cropped areas, projections were made for each factor, and the projection of demand was made by use of the formula cited above (2). With respect to the crops other than padi, oil palm and rubber, the demand for these crops was projected in aggregate, because the extent of influence of the demand for these crops on total demand is small.
- (5) The outline description of the method of making projections for each factor is as follows:
  - 1) Regarding the outlook for cropped area, see 1-2.
  - 2) Regarding the fertilized area, taking into account irrigation and drainage conditions, and type of farm management, the area thought to be the maximum attainable was estimated, and it was postulated that the fertilized area would gradually expand to that level.
  - 3) Regarding per hectare dosage, calculations were made on the basis of the recommended dosage for each crop. The future per hectare dosage is expected to gradually increase from the present level and approach the recommended level.
- (6) Using the volume of demand of nitrogen fertilizer thus obtained, and taking into account cultivation techniques as well as customary practices, the projection of demand for urea was made.

## 1-1-2 Projection of demand for urea for industrial use

Demand for urea for industrial use in Malaysia is primarily for use in making urea resin adhesive.

Projection of demand for urea for such use was made by projecting demand for plywood, and calculating the corresponding adhesive requirement, and checking this estimation by comparison with production capacity of existing and planned adhesive plants.

## 1-1-3 Ammonia demand projections

The method of projecting ammonia demand is discussed in Chapter 2, 2-3-2 of the main text.

According to information obtained by the Evaluation Study Team during the field survey, the consumption of ammonia for use in processing rubber seems to be in a small quantity, and there was no available data showing actual consumption of ammonia for this use. Demand for ammonia for use in processing rubber which was estimated by using the amount of concentrated latex produced and amount of ammonia required for one ton of concentrated latex, as is shown in the following table, is about 1,100 tons a year in maximum.

Further, since the proportion of low-ammonia concentrated latex to the total concentrated latex produced is gradually increasing because of quality-related considerations, the demand for ammonia from rubber processing is unlikely to increase significantly.

in the commence was increased and the contract of the contract

## Estimated Demand for Ammonia for Rubber Processing, W. Malaysia

ing. Mga nga pangahan nga pangahan ng	Karaman da	and the second second second	(ton)
		1975	1976
Export*1) of concentrated latex from  Concentrated latex containing		en e	
0.5 percent of ammonia		50,968	51,578
- Concentrated latex containing 0.5 percent of ammonia	more than	135,870	140,734
Total		186,838	192,312
Estimated ammonia consumption for of concentrated latex*2)	processing	1,053	1,088

Notes:

- \*1) Breakdown of production volumes of concentrated latex into low-ammonia and highammonia volumes was not available. However, as almost all of the concentrated latex produced was exported, the breakdown was estimated by using export volumes.
- \*2) Demand for ammonia was calculated on the basis of the following ammonia requirement for processing one ton of concentrated latex:

high-ammonia concentrated latex; 7 kg of ammonia low-ammonia concentrated latex; 2 kg of ammonia

## 1-2 Trend and Outlook for Planted Area in Malaysia

The historical trend and future outlook for the planted area of each crop are shown in Tables AII-1 to AII-6.

The method used to formulate the future outlook for planted area is as follows:

i) Padi: Future acreage for padi was based on padi production plans provided by the Ministry of Agriculture in Malaysia. This plan expects padi area in 1980 in an acreage smaller than in 1974 (in actuality, the padi planted area has been declining since 1974). The plan sets the 1990 target area as being 19% higher than that

in 1980, which is thought to be an attainable target.

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- ii) Rubber and oil palm: For each of the three groups of estates, smallholdings and government schemes, the following factors were investigated and trends of these factors were taken for use as the basis for projection.
  - 1) Replanting ratio ... Ratio of area replanted to rubber to the area of mature trees (in the case of rubber only)
  - 2) Ratio of diverting to other crops at time of replanting ... The ratio of [area replanted to crops other than rubber] to [area of rubber to be cut-down for replanting]
  - 3) Newly planted area ... Area of land not previously used, which is developed and planted to crops

计对象系统 化电影 经收货 化异戊基

4) Proportion of area cropped by year planted

and the land of the section of

iii) Other crops: Factors influencing change in planted area for each crop, plans for each scheme, and plans for and direction of agricultural policy were taken into account and planted area was estimated for each crop.

Regarding the government schemes, it is assumed that the revised target areas of the Third Malaysia Plan will be attained, and that from 1981 on, target areas equivalent to those of the Third Malaysia Plan will be adopted.

having the little from the color of the little for his factor of

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## 1-3 Recommended Dosage, and Trend of Fertilizer Application by Crop

- (1) The recommended dosages and historical values for application of fertilizer, by crop, used for making projections, are as given in Table AII-7.
- (2) Dosages used for projecting potential demand was estimated on the basis of the following information sources:
  - 1) Field interviews with:

MARDI, RRIM, MADA, FELDA, SLDB, Sarawak; SPB, Sabah; Sabah Depart-

ment of Agriculture, Several fertilizer distributors in both West and East Malaysia

## 2) Publication, etc.:

- K. Kanapathy, "Guide to Fertilizer Use in Peninsular Malaysia"
- ICI (Malaysia) Sdn. Bhd., "Fertilizer Handbook"
- (3) The method used to obtain the historical trend of fertilizer use by crop was as follows:
  - 1) Gross consumption: [(Imports) + (Domestic production) (Exports)] is taken as representing the "apparent consumption" for that year, and the three-year moving average of "apparent consumption" was used as the value for the central year of the three.
  - Wet padi: Data in Chapter 8, "Farming Practices as Observed through Crop Cutting Survey", in; Department of Statistics, Malaysia, "Crop Cutting Survey for Estimating Yield Rate of Padi".

P\$ 4.基本 (4.44) (2.45) (4.15) (4.45)

- 3) Rubber: Total fertilizer consumption for rubber was calculated by use of Department of Statistics, Malaysia, "Rubber Statistical Handbook, Malaysia".

  The nitrogen fertilizer share was calculated by the additional use of the NPK ratio in dosage standards given in the ICI's "Fertilizer Handbook".
- Oil palm: Taking the unit price of fertilizer used for rubber as being the same price as for oil palm; calculated from the values of fertilizer consumption given in the Department of Statistics, Malaysia, "Oil Palm, Coconut and Tea Statistics"; for the share of nitrogen fertilizer, the above-mentioned ICI handbook's NPK ratios were used.
- 5) Other crops: The remainder when the consumption for the above three crops is subtracted from gross consumption was taken as the consumption for "other crops".

1967   1968   1969   1970   1971   1972   1973   1974   1980	Estimated     Project       1968     1970     1971     1972     1973     1974     1980     198       1968     1970     1971     1972     1973     1974     1980     198       54     86     123     128     112     158     166     204     22       76     60     67     58     93     97     121     48     3       130     146     190     186     205     255     287     252     255       16     38     25     287     252     252     252       16     38     25     28     22     217     191     44     8       221     199     166     159     134     93     71     45     3       237     237     237     191     187     156     114     85     93     11	('000 ha)  tted  5 1990			Mis .	235	28	263	ć	777		126	15	141
Extimated       1967     1968     1970     1971     1972     1973     1974     1980       1967     1968     1970     1971     1972     1973     1974     1980       1967     1969     1970     1971     1973     1974     1980       133     54     86     123     128     112     158     166     204       7     7     7     66     67     58     93     97     121     48       110     130     146     190     186     205     255     287     252       110     38     25     28     22     217     191       14     48       239     221     134     93     71     45       246     237     237     191     187     1156     114     85     93	Extimated     Extimated       1967     1968     1970     1971     1972     1973     1974     1980       33     54     86     123     128     112     158     166     204       77     76     60     67     58     93     97     121     48       110     130     146     190     186     205     255     287     252       64     91     96     132     159     197     212     217     191       7     16     38     25     28     22     21     14     48       239     221     199     166     159     134     93     71     45       246     237     237     191     187     156     114     85     93	Projec 198				223	34	257		7		84	34	118
Estimated       1967     1968     1969     1970     1971     1972     1973     1       33     54     86     123     128     112     158       77     76     60     67     58     93     97       110     130     146     190     186     205     255       64     91     96     132     159     197     212       7     16     38     25     28     22     21       239     221     199     166     159     114     93       246     237     237     191     187     116     114	Estimated       1967     1968     1969     1970     1971     1972     1973     1       33     54     86     123     128     112     158       77     76     60     67     58     93     97       110     130     146     190     186     205     255       64     91     96     132     159     197     212       7     16     38     25     28     22     21       239     221     199     166     159     114     93       246     237     237     191     187     116     114					204	48	252	Š	121		48	45	93
Estimated       1967     1968     1969     1970     1971     1972     1       33     54     86     123     128     112       77     76     60     67     58     93       110     130     146     190     186     205       64     91     96     132     159     197       64     91     96     132     159     197       7     16     38     25     28     22       239     221     199     166     159     134       246     237     237     191     187     156	Estimated       1967     1968     1969     1970     1971     1972     1       33     54     86     123     128     112       77     76     60     67     58     93       110     130     146     190     186     205       64     91     96     132     159     197       64     91     96     132     159     197       7     16     38     25     28     22       239     221     199     166     159     134       246     237     237     191     187     156	1974				166	121	287	ţ	717		14	7.1	85
1967   1968   1969   1970   1971   11   110   130   146   190   186   159   159   159   159   166   159   150   186   159   150   166   159   150   187   191   187   191   187   187   191   187   187   191   187	1967   1968   1969   1970   1971   11   110   130   146   159   158   158   159   159   159   159   159   159   159   159   159   159   150	1973				158	97	255	,	717		21	93	114
1967   1968   1969   1970   1   133   54   86   123   196   113   110   130   146   190   130   146   190   130   146   130   130   146   130   130   146   130   146   131   146   131   146   131   146   131   146   131   146   131	Estimated 1967 1968 1969 1970 1 33 54 86 123 77 76 60 67 110 130 146 190 7 16 38 25 239 221 199 166 246 237 237 191	1972				112	93	205	į	19.		22	134	156
1967     1968     1969     19       33     54     86     11       77     76     60     6       1110     130     146     11       64     91     96     11       7     16     38       239     221     199     10       246     237     237     11	1967     1968     1969     19       33     54     86     11       77     76     60     60       1110     130     146     11       64     91     96     11       7     16     38       239     221     199     10       246     237     237     11	nated 1971	1			128	58	186	( !	154 		28	159	187
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Estir 1970				123	67	190		132		25	166	191
33 33 110 110 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	33 33 110 110 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	1969				98	09	146	•	႙		38	199	237
		1968				54	76	130		12		16	221	237
area eason which: Varea area area area carea area area area	Irrigated area Main season of which: HYV area LV area Total Off-season HYV area LY area LY area LY area LY area	1967				33	77	110	,	40		7	239	246
	Irrigated of of HY LV LV are HYV's Total Total		area	eason	which:	Varea	area	<b>tal</b> 2000 - 200	ason	v area	ed area	ırea	82	

Table AII-2 ACTUAL AND PROJECTED PLANTED AREA OF OIL PALM IN W. MALAYSIA

-Estates  Mature tree 71.1 Immature tree 58.3 Total 129.5 -Smallholdings	1968											:
Mature tree Immature tree Total	1968	•		Actual	ıal		14 1				Projected	
Mature tree Immature tree Total		1969	1970	1971	1972	1973	1974	1975	1976	1980	1985	1990
tree we tree			% <u>.</u>									
we tree	84.3	100.5	122.7	145.5	169.1	188.5	214.9	243.1	277.5	386.7	4803	508.0
allholdings	69.7	76.9	70.8 193.4	68.4 213.9	76.3 245.4	86.3 274.8	109.6 324.5	112.1 355.2	99.9 377.4	87.6 474.3	24.3 504.6	13.0
								:. :				
Mature tree												
FELDA 3.9	7.8	14.5	15.9	23.5	38.0	59.2	70.5	85.3	103.6	215.5	351.9	493.9 51.3
Others	N.A.	0.4	0.3	0.5	1.0	2.6	5.0	12.7	22.1	36.5	84.0	131.5
Sub-total	N.A.	14.9	16.2	24.0	39.0	61.8	75.5	98.0	125.7	260.3	466.2	676.7
Immature tree												
FELDA 20.3	29.0	36.9	49.1	53.0	58.8	65.3	85.3	863	111.9	108.0	113.6	113.6
RISDA						0.2	2.4	5.1	8.3	17.8	16.8	16.8
Others	N.A.	2.0	2.5	3.2	2.6	6.6	12.6	143	14.4	38.0	38.0	38.0
Sub-total	N A	38.9	51.6	56.2	64,4	75.4	100.3	115.7	134.6	163.8	168.4	168.4
Total	Z	53.8	8.79	80.2	103.4	137.2	175.8	213.7	260.3	424.1	634.6	845.1
-Total planted area												

Table AII-3 ACTUAL AND PROJECTED PLANTED AREA OF RUBBER IN W. MALAYSIA

				:					)	(2000 ha)	
				Actual				ρ.,	Projected		
	1970	1971	1972	1973	1974	1975	1976	1980	1985	1990	
- Estates											
Mature trees	544.7	533.9	522.1	508.0	490.1	472.4	462.2	429.6	405.7	398.2	
Of which 21 years and over	212.7	196.0	177.3	157.2	140.7	128.8	121.9	184.3	244.4	270.8	
Immature trees	101.9	1.76	88.2	81.5	84.1	6.06	91.1	83.9	78.0	73.4	
Total	97999	631.6	610.3	589.5	574.2	563.3	553.3	513.5	483.7	471.6	
– Smallholdings			. '	• •				• .		is in	
Mature trees										: .	
FELDA	23.7	34.5	36.9	40.8	43.7	44.5	45.9	105.1	155.7	206.3	
Of which 21 years and over FELCRA	0	0	1.0	2.1	3.7	5.7	8.3	23.6	26.7	26.7	
Of which 21 years and over	3296	351.2	383.5	399.3	414.4	435.9	454.2	555.9	622.1	624.9	
Of which 21 years and over		7 1 3 3	0 0	11.9	21.1	31.3	50.2	242.0	203.2	164.5	
Others Sub-total	929.1	937.1	939.6	925.3	926.7	930.6	945.1	926.6	1,007.7	1,022.4	
Immature trees			-							:	
FELDA	36.1	33.1	39.3	48.0	50.6	60.6	68.8	50.6	50.6	50.6	
FELCRA RISDA Sub-total	5.7 106.4 148.2	8.3 108.0 149.4	14.0 79.1 152.4	19.4 111.9 179.3	19.9 120.4 190.9	20.4 120.0 201.0	116.0	105.0 158.7	41.6	31.1	
Total	1,077.3	1,086.5	1,092.0	1,104.6	1,117.6	1,131.6	1,147.8	1,085.3	1,099.9	1,104.1	
- Total rubber planted area	1,723.9	1,718.1	1,702.3	1,694.1	1,691.8	1,694.9	1,701.1	1,598.8	1,583.6	1,575.7	
										٠.	1

(2000 ha) Table AII-4 ACTUAL AND PROJECTED PLANTED AREA OF MISCELLANEOUS CROPS IN WEST MALAYSIA

Cocomit										
				Actual				*	Projected	
- Cocomit	1970	1971	1972	1973	1974	1975	9761	1980	1985	1990
Estates	22.4	21.6	20.7	18.8	18.0	17.4	17.2	14.3	12.1	10.8
Cocoa	4.6	7.5	12.1	11.6	13.6	17.6		26.9	36.2	45.5
— Pineapple										
Estates	5.0	6.1	6.1	6.1	6.1	6.1		7.1	7.9	8.7
Smallholdings (for canning only)	11.3	11.3	11.3	11.3	11.3	11.3		6.4	6.4	6.4
Total	16.3	17.4	17.4	17.4	17.4	17.4		13.5	14.3	15.1
Sugarcane										
FELDA			8.0	2.0	3.5	4.0	4.0	7.6	11.6	15.6
Others	5.6	6.7	13.7	16.9	16.9	16.9	16.9	16.9	16.9	16.9
Total			14.5	18.9	20.4	20.9	20.9	24.5	28.5	32.5

Table AII-5 ACTUAL AND PROJECTED PLANTED AREA OF MAIN CROPS IN SABAH

(7000 ha)

1. "这个人,我们就是一个人,我们就是一个人,我们就是一个人,我们就是一个人,我们就是一个人,我们就是一个人,我们就是一个人,我们就是一个人,我们就是一个人,我们就是一个人,我们就是一个人,我们就是				Actual	ual					Projected	
	1969	1970	1971	1972	1973	1974	1975	1976	1980	1985	1990
- Wet Padi						Pr			4	4.1	. •
Main ceason		31	32.8	32.5	32,8	33.8	29.3	31.3	33.5	33.5	33.5
Off-season		1.8	2.5	3.9	5.7	3,	8,6	2.1	6.5	0.6	11.5
Total		32.9	35.3	36.4	38.5	37.6	33.1	33.4	40.0	42.5	45.0
– Oil Palm	•				• .			; ,	e .		
Fistates	19.4	20.2	21.7	23.1	28.5	29.7	30.6	34.4	40.0	20.0	60.0
Land schemes	8.5	11.9	13.5	14.8	17.6	19.5	23.9	31.2	75.0	65.0	0 \$8
Smallholdings	1.4	4.	2.9	5.0	5.7	5.0	3.4	2.6	? }	}	}
Total	29.3	33.5	38.1	42.9	51.8	54.2	57.9	68.2	85.0	115.0	145.0
- Rubber	2 <sup>*</sup> .			`.				·			÷.
Estates	29.2	27.4	24.6	24.7	20.0	19.6	17.4	17.1	16.3	15.8	15.5
Land schemes	3.9	.6	3.7	3.4	3.2	3.2	4.1	3.8	5.5	6.5	7.0
Smallholdings	72.6	74.4	76.7	76.4	80.7	81.2	82.3	87.3			
Total	105.7	105.4	105.0	104.5	103.9	104.0	103.8	108.2			v .
() () () () () () () () () () () () () (		4 0.	4.5	5.5	6.2	8.1	8.6	11.7	25.0	40.0	55.0

				Actual					1 1	Projected	
1969			1971	1972	1973	1974	1975	1976	1980	53.5	53.5
į,	51.6 61	61.6	1.70	7.84	.nc	٠ ئ	700.1	(41.7)	<u>,</u>	, ,	}
N.A.	A. N.A.		N.A.	N.A.	Z.	N.A.	N.A.	23.6	24.0	25.0	26.0
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1											
0	0.2 0	9.0	4	2.2	3.1	3.6	4.0	4.1	4.5	4.9	5.2
•	0	0.4	13	3.3	4.6	7.6	11.1	12.3	14.5	17.3	20.1
	0	0	0	0	0.1	0.4	9.0	9.0	0.7	0.8	0.9
•	0.2	1.0	2.7	5.5	7.8	11.6	15.7	17.0	19.7	23.0	26.2
							* · · · · · · · · · · · · · · · · · · ·		. *. *.		
	3.2	3.1	3.0	3.0	2.8	2.8	2.7	2.7	2.6	2.5	2.4
73	5.4	5.8	5.8	5.8	5.5	5.5	5.5	5.5	5.5	\$.	5.5
178.3		181.4	184.1	184.1	184.5	184.6	184.7	184.7			
186.9		190.3	192.9	192.9	192.8	192.9	192.9	192.9			

Table AII-7 ESTIMATED POTENTIAL DOSAGES OF NITROGEN FERTILIZERS BY CROP, MALAYSIA

Crops		Estimated Potential Dosages (N kgs/ha)		Suitable Types of Fertilizers	Notes
Padi	Region I	Region II	Region III U	0.000 0.0000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00000 0	
	HYV main season 95	<b>48</b>	19		
	off-season 78	56	56 45 45 47 48 48 48 48 48 48 48 48 48 48 48 48 48		
	70				
Rubber	Mature trees	<b>40</b>		AS/AN/CX Effecti rubber	Effects of refulzer use on rubber is good for trees below
	Immature trees	32		20 yea	20 years in age.
Oil palm	Mature trees Immature trees	41.3		On coastal clay: U/CX On inland soils: AS/AN/CX	
			1.41 1.41		
Sugarcane					
Pineapple		280			
Cocoa		45 C. A.		-U/AN/CAN/CX -Sulphur-containing fertilizer	
	ingers Stephen			is not suitable	
Coconut	Mature trees	9		-U/AN/CAN/ACL/CX Solt-hur-containing fertilizers	
			•	are not advisable	
	100				

lote: Abbreviations used for suitable types of fertilizers are:

U. Urea AS. Ammonium sulphate AN. Ammonium nitrate CAN. Calcium ammonium nitrate. ACL. Ammonium Chloride.

## APPENDIX II-2 PROJECTION OF UREA TRADE

- In projecting urea trade volume in the world, the outlook for world demand for nitrogen fertilizer was projected first (the results of this projection are given in Table AII-8), and then trade of nitrogen fertilizer was projected on the basis of that. In projecting the volume of trade in nitrogen fertilizer, with the exception of the following regions, the difference between supply and demand of nitrogen fertilizer was taken as equivalent to the volume of trade; for the regions noted below, the historical trade (see Table AII-9) shows a lack of equivalence between the difference in supply and demand and the volume of trade, and therefore the projections were made with the following points in mind:
  - (1) In the case of West Europe as well as the North American countries, because they do importing on one hand and exporting on the other, the volume of trade would be greater than the total of individual countries' differences between supply and demand. As may be seen in Table AII-9, a relationship exists between (a) import volume and demand volume, and between (b) export volume and supply volume; this is because the importers and exporters have their respective sales channels. Therefore, import volume and export volume were projected in relation to each country's demand volume and supply volume.
  - (2) In the case of East Europe, there is a tendency for the volume of imports to exceed the required volume of imports and for the volume of exports to be less than the exportable volume. This is believed to be a reflection of each country's efforts at building up domestic stocks. The projection of trade volume takes this into account.
- 2-2 The volume of urea trade was calculated on the basis of the past trend of urea's percentage of nitrogen fertilizer trade in each regions.

The results are shown in Table AII-10.

Table AII-8 WORLD NITROGEN FERTILIZER SUPPLY, DEMAND AND BALANCE

and a second sec		Actua	al		Projected	
		1975/76	1977/78	1980/81	1985/86	1987/88
.E. Asia	S	361	570	1,153	2,328	2,458
.D. Asia	Ď	858	1,235	1,518	1,900	2,036
	B	-497	-665	-365	428	422
.W. Asia	S	1,994	2,450	3,605	5,461	6,235
	D	2,698	3,804	4,479	6,176	6,875
n Haji	В	-704	-1,454	-874	<b>-71</b> 5	-640
. Asia	S	5,658	7,155	9,569	10,066	9,945
G. Art.	D	5,928	7,424	8,527	9,601	10,027
y A	В	-270	-269	1,042	465	-82
/ideast	S	837	1,026	1,730	3,023	3,180
	Ď	787	1,030	1,184	1,443	1,526
	В	50	-4	546	1,580	1,654
Oceania	S	180	215	182	379	371
	D	185	243	286	356	383
	В	-5	-28	-104	.23	-12
V. Europe	S	8,932	9,706	10,601	12,618	12,870
	D	7,743	8,353	9,340	10,852	11,461
Tarker Section	В	1,189	1,353	1,261	1,766	1,409
E. Europe	<b>S</b> .	13,873	15,090	20,539	28,145	28,126
	D	11,870	12,093	16,134	18,952	19,722
ing specific National Specific Control	В	2,003	2,997	4,405	9,193	8,404
N. America	S	10,178	11,281	13,134	13,945	13,677
	D.	9,947	9,687	11,479	13,528	14,348 671
	В	231	1,594	1,655	417	
C. America	S	727	752	1,994	2,734	2,738
	D	1,223	1,308	1,418	1,588	1,641 1,097
	В	-496	-556	576	1,146	
S. America	S	481	607	813	2,301	2,667
	. D	799	1,268	1,497	1,900	2,007 660
•	В	-318	-661	-684	401	
Africa	S	611	759	1,237	2,453	2,607
in the second se	D	1,247	1,323	1,863	2,481	2,729
	В	-636	-564	-626	-28	-122
World Total	S	43,832	49,611	64,557	83,453	84,874
	D	43,285	47,768	57,725	68,777	72,755
	В	547	1,843	6,832	14,676	12,119

Note:

Supply (in the case of past) or Supply ability (in the case of projection) S: Demand Action of the Case of pasts of supply ability (in the case of projection)

Balance

D:

B:

ું કરવા કર્યું કરવા કરાયું છે. આ પ્રેસિક્સ કાર્યો કરો છે છે ત્યારે છે. ત્યારે સ્ટ્રીક્સ ક્લોનો માન્ય કરો છે છે

COMPARISON BETWEEN SUPPLY/DEMAND BALANCE AND NET EXPORT OF NITROGEN FERTILIZERS, WORLD BY REGION

(N '000 ton)

Mot   22   46   24     Net X   34   28   8     B   38   -21   5     W. Europe					(14 000 1011)
More   More			1971/72	1972/74	1975/76
More   More	Asia	X	1.577	1.738	1,224
Net X			2.857	3,473	3,345
B			-1.280	-1.735	-2,121
Mot X   34   28   8   8   8   8   8   8   8   8					
Mot X   34   28   8   8   8   8   8   8   8   8	Oceania	X	56	18	16
Net X   34   -28   8   8   8   2-1   5   5	, keep	M	22	46	24
B   38		Net X	34	-28	-8
Mot X 1,315 1,445 1,606 Net X 1,327 1,858 1,056 B 1,549 1,934 1,189 D 6,822 7,411 7,743 M/D (%) 19.3 19.5 20.7 S 8,371 9,345 8,932 X/S (%) 31.6 35.3 29.8 E. Europe X 1,221 1,520 1,635 M 391 492 341 Net X 830 1,028 1,294 B 1,385 1,568 2,003 Import Requirement (a) 305 324 224 M/a (%) 128.2 151.9 152.2 Export Potentiality (b) 1,690 1,892 2,227 X/b (%) 72.2 80.3 73.4 N. America X 1,375 1,206 1,290 M 1,284 476 586 B 1,274 1,151 231 D 7,622 8,810 9,947 M/D (%) 10.2 8,3 7,1 S 8,896 9,961 10,178 X/S (%) 15.5 12.1 12.7 C. America X 161 135 76 M 503 582 573 Net X 342 -447 497 B -496 S. America X 161 135 76 M 534 488 488 405 Net X 342 -447 497 B -496 S. America X 133 33 33 37 Net X 348 488 405 Net X 2257 4421 3330 B -262 420 -318 Africa X 33 33 33 37 Net X 348 488 405 Net X 2257 4421 3330 B -262 4420 -318 Africa X 33 33 33 37 Net X 257 4421 3330 B -262 4420 -318 Africa X 33 33 33 37 Net X 257 4421 3330 B -262 4420 -318 Africa X 33 33 33 37 Net X 348 488 405 Net X 257 4421 3330 B -262 4420 -318 Africa X 33 33 33 37 Net X 358 595 651 Net X -257 4421 3330 B -262 4420 -318 Africa X 33 33 33 37 Net X 358 595 651 Net X -257 4421 3330 B -262 4420 -318 Africa X 33 33 33 37 Net X 358 595 651 Net X -257 4421 -3330 B -262 4420 -318 Africa X 333 33 33 37 Net X 358 595 651 Net X -257 4421 -3330	Take a second		38	-21	-5
Net X	W. Europe	X		3,303	2,662
B	8 1 4 2 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6		1,315	1,445	1,606
D		Net X		1,858	
M/D (%)	The state of the s	В	1,549	1,934	1,189
M/D (%)		$\mathbf{D}^{\prime}$	6.822	7.411	7.743
S					
E. Europe X 1,221 1,520 1,635 M 391 492 341 Net X 830 1,028 1,294 B 1,294 B 1,385 1,568 2,003 Import Requirement (a) 305 324 224 M/a (%) 128.2 151.9 152.2 Export Potentiality (b) 1,690 1,892 2,227 X/b (%) 72.2 80.3 73.4 N. America X 1,375 1,206 1,290 M 781 730 704 Net X 594 476 586 B 1,274 1,151 231 D 7,622 8,810 9,947 M/D (%) 10.2 8,3 7.1 S 8,896 9,961 10,178 X/S (%) 15.5 12.1 12.7 C. America X 161 135 76 M 503 582 573 Net X 342 447 447 497 B 406 455 496 S. America X 191 67 75 330 B 405 Net X 348 488 405 Net X 348 488 405 Net X 348 488 405 Net X 328 33 33 37 Met X 348 488 405 Net X 328 33 33 37 Met X 348 488 488 405 Net X 326 447 330 Net X 326 447 330 Net X 326 447 330 Net X 327 421 330 Net X 328 33 33 37 Met X 348 488 488 405 Net X 325 420 318 Africa X 33 33 33 37 Met X 326 440 338 33 37 Met X 326 440 338 33 37 Met X 328 33 33 37 Met X 326 440 338 348 388 340 340 340 340 340 340 340 340 340 340			8.371		8,932
M. Net X     391     492     341       B     1,385     1,568     2,003       Import Requirement (a)     305     324     224       M/a (%)     128.2     151.9     152.2       Export Potentiality (b)     1,690     1,892     2,227       X/b (%)     72.2     80.3     73.4       N. America     X     1,375     1,206     1,290       M     781     730     704       Net X     594     476     586       B     1,274     1,151     231       D     7,622     8,810     9,947       M/D (%)     10,2     8,3     7.1       S     8,896     9,961     10,178       X/S (%)     15.5     12.1     12.7       C. America     X     161     135     76       M     503     582     573       Net X     342     -447     -497       B     406     455     -496       S. America     X     91     67     75       M     348     488     405       Net X     257     -421     -330       B     -262     -420     -318       Africa     X     33		X/S (%)			
Net X   830   1,028   1,294	E. Europe			1,520	
B	ing the contract of the contra				
Import Requirement (a)   305   324   224     M/a (%)   128.2   151.9   152.2     Export Potentiality (b)   1,690   1,892   2,227     X/b (%)   72.2   80.3   73.4     N. America   X   1,375   1,206   1,290     M   781   730   704     Net X   594   476   586     B   1,274   1,151   231     D   7,622   8,810   9,947     M/D (%)   10.2   8.3   7.1     S   8,896   9,961   10,178     X/S (%)   15.5   12.1   12.7     C. America   X   161   135   76     M   503   582   573     Net X   -342   -447   -497     B   406   455   496     S. America   X   91   67   75     M   348   488   405     Net X   -257   421   330     B   262   420   318     Africa   X   33   33   37     M   578   595   651     Net X   333   33   37     M   578   595   651     Net X   107   562   614     B   4471   623   636     World   X   7,156   8,020   7,015				1,028	
M/a (%)		B	1,385	1,568	2,003
M/a (%)	' i .	Import Requirement (a)	305	324	224
Export Potentiality (b)	er de la companya de	M/a (%)	128.2		152.2
X/b (%)   72.2   80.3   73.4     N. America   X   1;375   1,206   1,290     M   781   730   704     Net X   594   476   586     B   1,274   1,151   231     D   7,622   8,810   9,947     M/D (%)   10.2   8.3   7.1     S   8,896   9,961   10,178     X/S (%)   15.5   12.1   12.7     C. America   X   161   135   76     M   503   582   573     Net X   342   447   497     B   406   455   496     S. America   X   91   67   75     M   348   488   405     Net X   257   421   -330     B   -262   -420   -318     Africa   X   33   33   37     M   578   595   651     Net X   -107   -562   614     B   471   -5623   -536     World   X   7,156   8,020   7,015	Market Comment	Export Potentiality (b)	1,690	1,892	2,227
M     781     730     704       Net X     594     476     586       B     1,274     1,151     231       D     7,622     8,810     9,947       M/D (%)     10.2     8.3     7.1       S     8,896     9,961     10,178       X/S (%)     15.5     12.1     12.7       C. America     X     161     135     76       M     503     582     573       Net X     -342     447     497       B     406     455     496       S. America     X     91     67     75       M     348     488     405       Net X     -257     -421     -330       B     262     -420     -318       Africa     X     33     33     37       M     578     595     651       Net X     -107     -562     614       B     -471     -623     -636       World     X     7,156     8,020     7,015		X/b (%)	72.2	80.3	73.4
Net X       594       476       586         B       1,274       1,151       231         D       7,622       8,810       9,947         M/D (%)       10.2       8.3       7.1         S       8,896       9,961       10,178         X/S (%)       15.5       12.1       12.7         C. America       X       161       135       76         M       503       582       573         Net X       -342       -447       -497         B       -406       -455       -496         S. America       X       91       67       75         M       348       488       405         Net X       257       -421       -330         B       -262       -420       -318         Africa       X       33       33       37         M       578       595       651         Net X       -107       -562       614         B       -471       -623       -636         World       X       7,156       8,020       7,015	N. America		1,375	1,206	
B 1,274 1,151 231  D 7,622 8,810 9,947  M/D (%) 10.2 8.3 7.1  S 8,896 9,961 10,178  X/S (%) 15.5 12.1 12.7  C. America X 161 135 76  M 503 582 573  Net X 342 -447 497  B 406 -455 496  S. America X 91 67 75  M 348 488 405  Net X 257 421 330  B 262 420 318  Africa X 33 33 37  M 578 595 651  Net X 107 -562 614  B 471 -623 -636  World X 7,156 8,020 7,015			781	730	
D   7,622   8,810   9,947     M/D (%)   10.2   8.3   7.1     S   8,896   9,961   10,178     X/S (%)   15.5   12.1   12.7     C. America   X   161   135   76     M   503   582   573     Net X   342   -447   -497     B   406   -455   496     S. America   X   91   67   75     M   348   488   405     Net X   2-257   -421   330     B   2-262   -420   318     Africa   X   33   33   37     M   578   595   651     Net X   107   -562   614     B   471   623   636     World   X   7,156   8,020   7,015	840 A S. C.	Net X	594	476	586
M/D (%)     10.2     8.3     7.1       S     8,896     9,961     10,178       X/S (%)     15.5     12.1     12.7       C. America     X     161     135     76       M     503     582     573       Net X     342     -447     -497       B     406     -455     -496       S. America     X     91     67     75       M     348     488     405       Net X     2-57     -421     -330       B     -262     -420     -318       Africa     X     33     33     37       M     578     595     651       Net X     -107     -562     -614       B     -471     -623     -636       World     X     7,156     8,020     7,015	A Section	B <sub>interested</sub>	1,274	1,151	231
M/D (%)     10.2     8.3     7.1       S     8,896     9,961     10,178       X/S (%)     15.5     12.1     12.7       C. America     X     161     135     76       M     503     582     573       Net X     342     -447     -497       B     406     -455     -496       S. America     X     91     67     75       M     348     488     405       Net X     2-57     -421     -330       B     -262     -420     -318       Africa     X     33     33     37       M     578     595     651       Net X     -107     -562     -614       B     -471     -623     -636       World     X     7,156     8,020     7,015	35,400	D	7.622	8.810	9.947
S X/S (%)     8,896     9,961     10,178       X/S (%)     15.5     12.1     12.7       C. America     X     161     135     76       M     503     582     573       Net X     -342     -447     -497       B     -406     -455     -496       S. America     X     91     67     75       M     348     488     405       Net X     -257     -421     -330       B     -262     -420     -318       Africa     X     33     33     37       M     578     595     651       Net X     -107     -562     614       B     -471     -623     -636       World     X     7,156     8,020     7,015	A STATE OF THE STA	M/D (%)		8.3	
X/S (%)     15.5     12.1     12.7       C. America     X     161     135     76       M     503     582     573       Net X     -342     -447     -497       B     406     -455     -496       S. America     X     91     67     75       M     348     488     405       Net X     -257     -421     -330       B     -262     -420     -318       Africa     X     33     33     37       M     578     595     651       Net X     -107     -562     614       B     -471     -623     -636       World     X     7,156     8,020     7,015	artin de la companya	<b>S</b> ·			
M         503         582         573           Net X         -342         -447         -497           B         406         -455         -496           S. America         X         91         67         75           M         348         488         405           Net X         -257         -421         -330           B         -262         -420         -318           Africa         X         33         33         37           M         578         595         651           Net X         -107         -562         614           B         -471         -623         -636           World         X         7,156         8,020         7,015		X/S (%)		12.1	12.7
Net X     -342     -447     497       B     -406     -455     -496       S. America     X     91     67     75       M     348     488     405       Net X     -257     -421     -330       B     -262     -420     -318       Africa     X     33     33     37       M     578     595     651       Net X     -107     -562     614       B     -471     -623     -636       World     X     7,156     8,020     7,015	C. America			135	
B .406 -455 -496  S. America X 91 67 75  M 348 488 405  Net X -257 -421 330  B -262 -420 318  Africa X 33 33 37  M 578 595 651  Net X 107 -562 614  B -471 623 636  World X 7,156 8,020 7,015	القارطين وأرواني	M			
S. America     X     91     67     75       M     348     488     405       Net X     257     -421     330       B     262     -420     318       Africa     X     33     33     37       M     578     595     651       Net X     107     -562     614       B     -471     -623     -636       World     X     7,156     8,020     7,015					
M         348         488         405           Net X         2.57         -421         330           B         -262         -420         -318           Africa         X         33         33         37           M         578         595         651           Net X         107         -562         614           B         -471         -623         -636           World         X         7,156         8,020         7,015					
Net X         -257         -421         330           B         -262         -420         318           Africa         X         33         33         37           M         578         595         651           Net X         -107         -562         614           B         -471         -623         -636           World         X         7,156         8,020         7,015	S. America	$-\mathbf{X}$			
B 262 -420 318  Africa X 33 33 37  M 578 595 651  Net X 107 -562 614  B 471 623 636  World X 7,156 8,020 7,015					
Africa     X     33     33     37       M     578     595     651       Net X     107     -562     614       B     -471     -623     -636       World     X     7,156     8,020     7,015					
M 578 595 651 Net X 107 -562 614 B 471 -623 636 World X 7,156 8,020 7,015	Africa	<del></del>			
Net X -107 -562 -614 B -471 -623 -636 World X 7,156 8,020 7,015	Aillea				
B -471 -623 -636 World X 7,156 8,020 7,015			-107		
World X 7.156 8,020 7.015				600	
6,795 7,851 7,649	World				
			6,795	7,851	7,649

Notes:

- Abbreviation used are;
  - X-Export, M-Import, Net X-Net export (= X-M)

- B-Balance between supply and demand [= (Supply) (Demand)] But the selection of the selection of the selection of
- D-Demand, S-Supply
- 2. "Import requirement" means the total of supply deficits of individual countries in the region.
- "Export potentiality" means the total of supply surpluses of individual countries in the reigon.

Table AII-10 PROJECTION OF UREA TRADE

(N '000 ton)

				<u> </u>			
		1979	1981	1983	1985	1987	1990
S.E.Asia	Import	402	471	501	411	401	477
**************************************	Export	250	431	564	656	621	558
S.W. Asia	Import	391	502	680	265	482	499
	Export	11	23	244	351	221	, <b>.90</b>
E. Asia	Import	444	351	541	556	727	708
	Export	1,083	1,393	1,300	1,225	1,011	871
Mideast	Import	668	294	197	68	71	13
	Export	348	528	790	907	916	1,132
Oceania	Import (or Export)	36	48	25	(9)	5 	22
W. Europe	Import	120	128	136	144	152	164
e della per la la la la la le la	Export	916	960	1,042	1,090	1,112	1,115
E. Europe	Import	389	170	216	214	242	269
e trata e deserviciones de la compansión d La compansión de la compa	Export	1,883	2,548	3,345	3,941	3,655	3,387
N. America	Import	296	318	340	362	383	416
	Export	316	356	363	366	359	332
C. America	Export	612	633	836	1,146	1,097	1,542
S. America	Import (or Export)	231	201	89.	(120)	(198)	(318)
Africa	Import	387	246	34	18	<b>79</b>	85
World Total	Import	3,364	2,729	2,759	2,038	2,542	2,653
en i neire begaren. Gibboren 1886 eta	Export	5,419	6,872	8,484	9,811	9,190	9,345

Note:

Import - Projected import amount

Export - Projected amount of potential export

## APPENDIX II-3 BASE DATA FOR PROJECTION OF INTERNATIONAL MARKET PRICES OF AMMONIA AND UREA

- 3-1 The main assumed factor prices used for projecting international prices are given in Table AII-11.
- 3-2 The prices given in Table AII-11 were mostly obtained by extending price trends of 1973-1979 (estimates) into the future, although special consideration was given to the following.

Natural gas price: The changes in price of natural gas have displayed completely different movement according to the following three categories of countries:

- i) Industrial countries: In these countries, large quantities of natural gas are consumed not only for industrial use but also for home use and therefore these countries have a high level and wide variety of demands for natural gas. Moreover, when the cost of other sources of energy increases, natural gas substitutes for part of the demand for those sources. For that reason natural gas has shown a close relationship to energy prices and since late 1970's in particular the price per calory of natural gas has tended to come closer to the price for other energy sources (see Fig. II-3).
- demand for natural gas is low relative to its supply, although their situations vary depending on the level to which natural gas-using industries have been developed. In these countries, the most prospective demand for natural gas is for production of LNG for export. But since LNG demand in the world is still in a limited extent, because the development of LNG projects requires enormous cost and time and, moreover, the number of countries who would import LNG is limited, it will be some time before LNG is widely used in the world to substitute other sources of energy, in response to changes in the price of those energy sources.

At that stage of development, it is general for the price of natural gas to be supplied to the ammonia industry to be set independently of the prices of other energy sources, and to be set at a low level in order to promote the development of the ammonia industry.

For projection of the natural gas price in the present study, taking the foregoing conditions into consideration, it was assumed that in these countries, up to 1985 there would not be major price increases beyond current levels, and that after 1985 the price of natural gas would gradually approach that of other energy sources, in accompaniment with growth of the utilization of natural gas for LNG.

Developing, non-oil-producing countries: The price of natural gas in countries lacking any domestic sources of energy other than natural gas is set in response to the prices of imported energy. Thus, the manner of price formation of the natural gas is fairly similar to that in industrial countries; however, in contrast to the industrial nations, because there is little competition between industrial and household users, and also because of considerations related to national policy for domestically-produced energy (e.g., the impact on prices in general) it is assumed that it is not as directly related to other energy sources' prices as in the industrial countries.

Table AII-11 MAIN ASSUMED FACTOR PRICES USED IN FORECASTING INTERNATIONAL MARKET PRICES OF UREA

					į	Annual	lal		(		Ant	Annual increase rate	rate
			1973	1975	1979	increase rate	rate	1980	1985	1990	1975-80	1980-85	1985-90
		•				1973-79	1975-79						. * :
1	Feedstock prices:									is in the second			
	- NG		. 0	: 02	106	38	33 X	2.8	4.19	5.55	30.3	14.0	5.8
	U.S.A.	(USS/MMBIU)	44 8	100	320.7			375.9	722.4	6.956	·. ·		
	Transcis	(TS\$/WMBTU)	0.22	0.35	09'0	18.2	14.4	0.67	1.00	3.89	13.9	83	31.2
,	THEOMOSIA	(1975 = 100)	62.9	100	171.4			191.4	285.7	1111.4			
٠.	Mideast	(US\$/MMBTU)	0.01	0.05	0.30	76.3	56.5	0.36	0.54	2.66	48.4	8.5	ં ઝ
		(1975 = 100)	20.0	100	0.009			720.0	1080.0	5320.0			•
	W Farone	(US\$/MMBTU)	0.53	0.87	3.03	33.7	36.6	3.57	91'9	7.37	32.6	11.5	3.7
		(1975 = 100)	6.09	100	348.3			410.3	708.1	847.1		-	
	Nombrho		• .					: . 1			. (c.) (c.)		<i>y</i> :
II-2	- Itapin aa Ianan	(T/SS/T)	58.7	115.1	199.6	22.6	14.8	210.1	305.0	400.0	12.8	1.7	5.6
30	and a	(US\$/MMBTU)	1.33	2.62	4.54		•	4.78	6.93	60.6			
٠		(1975 = 100)	51.0	100.0	173.4			182.5	265.0	347.5			
	W Furone	(T/\$\$/T)	68.3	120.0	252.5	24.4	20.4	219.0	318.0	417.0	12.8	7.7	5.6
		(US\$/MMBTU)	1.55	2.73	5.74			4.98	7.23	9.48			
•		(1975 = 100)	56.9	100.0	210.4			182.5	265.0	347.5			: '
	- Crude Oil	(US\$/BBL)	3.3	11.5	14.9	28.5	6.7	19.8	28.7	36.5	11.5	7.3	5.5
		(USS/MMBTU)	0.56	1.94	2.51			3.34	4.76	6.15			٠.
		(1975 = 100)	28.7	100.0	129.6			172.5	245.0	317.5			
٠.					-								
	Index numbers of whole sale prices	whole sale prices	-							: .			12-1
		(1975 = 100)							Ç	4	0	٧.٧	4
	Developed countries	ntries	77.8	100.0	135.8	9.7	8.0	147.5	195.0	C-747	7.0		•
	- Developing countries	ntries	6.09	100.0	152.0	16.5	11.0	162.5	225.0	287.5	10.2	6.7	) (
	Index numbers of waon rates	wace rates	•			\$							
	דו פוסטווייון עסטוויי	(1975 = 100)					. :				H.	į	
	- Developed countries	ntries	84.8	100.0	143.5	9.2	9.5	157.5	215.0	272.5	9.5	4. 0	4 n
			603	1000	1570*)	17.0	16.5	177.5	255.0	332.5	12.2		

Note: \*) In 1978

# APPENDIX III

속의 말한다니요? 이 의 대한 지원들은 이 없고 있다. 이 사는 것이 많다. 후 생물에 안들 가장 안된 것 같은데?	
어머니의 경기 가는 하고 있는데 모든 모든 가 되어 모든 사람들이 어떻게 하는데 하는데 그릇들은 그 모든 그 모든	
교하세요 그는 전에는 있는데 얼마 하고 되는데 되는데 되는데 그 그 그는데 하는데 그리고 있는데 없네요요?	
어떤 선생님, 그 취임은 항문의 있었다. 사회는 이유는 상대 선택적으로 한번만 하는 영구실의 불통문을 모른	
그리는 경찰하다는 것으로 말했다는 것 같은 사람들이 모든 사람들이 가는 것이 없는 것이 없는 그렇게 되었다.	
1、1996年1月1日中国民民民工学院、新兴、新兴、新兴、新兴、新兴、大学、新兴、新兴、新兴、新兴、新兴、新兴、新兴、新兴、新兴、新兴、新兴、新兴、新兴、	
나는 동생님은 모두 지원들은 일본에 이 어떤 사람들이 했다. 그는 사람들은 모양한 나를 받는 것을	
그런 아이들은 지난 이 일을 들어 된 것이 그 회교를 만들었다. 리스리 경험은 글론이 이렇게 들어나?	
보는 물이 그리고 하다 그들은 이 회사들이 많은 아니라를 받았는데 그를 하는데 하는 병인의 회인 회문인	
가는 되다 하늘 물건은 전 동안은 물 이 이 모양 말하는 한다는 후의 그리었다면서는 이 출산을 받는데 되었다.	
나는 사람이 들어 있는 사람들 보는 것 같아. 그는 내 전문하다는 사회 사람들의 중요점에 가지 않는 것 같아.	
그는 회사들에는 어린다니는 사람들은 그는 그릇 회사를 가는 사람들은 사람들에 가는 것을 모르는 것을 가지 않는데 함께 다른 사람들이 되었다.	
化铁矿 缺重的 缺陷 经付付的 网络英国拉克斯 化二氯酸二甲二乙二胺异苯基基 电影光谱性 经过的复数分配帐 医小囊	
그 문에 하는데 생생님이 나는 이 나는데 이 살았다. 이는 것이 말할 때 나는데 것은 느낌이 하지 않아니다. 중요 생각을	
그리는 그 생생이에 가는 그 살았면요. 얼마일속 그림 그 음속에 나라 빨릴 때 하고 있었다.	
그리다 그리는 이렇게 되는 이 이번 나는 나는 나라를 내려면 하는 이번 하는 이 등에 가장 되었다.	
그런 가는 일 이렇다는 이 그 나는 하는 이 된다는 사람이 되는 사람이 되었다. 이 주민은 이 없어요.	
진화 원을에 타고 있다. 그리고로 한 하는 사는 그는 마음하는데 일반으로 그리다면 그 만나게 되는	
(BEC) 보고 하는 이 하다 목표를 받는데 보는데 있다면 하는데 이 하다. 하는데 보고 아이들도 생활하는 모든데 되었다.	
그렇게 되는 생님 어떻게 되었는데 되었는데 얼마는 사람이 다른 하는 사람이 가장 하는데 다른데 다른데 다른데 하다.	
그 등록 한숨을 되고 하고 있었다. 그들은 그들은 그들은 그는 하는 그 그는 그는 그를 가장 하고 있다. 우리 아름다는 학	
사진 사진 한 중에 대답하는데 사진 수회가 되고 있는데 그는데 하는데 하는데 그렇게 되는데 그를 하는데 그리고 없다.	
그래 살아도 시장 시작에 다른 아내가 되었다. 그는 그는 그는 그는 사람들은 그는 사람들이 되었다. 나는 모양하	
그들로 발생 중에 있었다. 그는 이 시민 사람들 하는 그는 사람에 만든 것이라고 있다. 그를 모양하는 것이 되었다. 나를 다.	
물에 하는 마른얼굴로 보면 그러나 말이 되는 그가 되는 것은 이 것은 그 것을 잃었다. 보다는 말을 하고 되었다. 내일 전	
그들은 아내고 하는 사물리 하고 이 가 있는 사람들은 그 사람들이 무충한 학생들의 전환을 하다니는 것이 사람들이다.	
어디다. 그렇게 다양하는 도리의 리트는 제한 문항을 가서 나는 현재를 가는 사고 있는데 화면 사기를 하는 것이다.	
- 진동생 그는 전문화 장면보다. 하면 동작론의 하는데 그 회장 그 날까지 수 화는 지금 어떻게 되었다. 어떤 학생들이	
그런 하는데 된 그 한 그리고 가는 하는만 하는 일은 나는 그 문학생활한 당한 눈을 지는 점점이는 한 것으로 나는다.	
어떤 사람들이 많았는데 맞았다. 나를 통한 어느 때문의 사람들이 하는데 그렇지만 나는 아니라는 나를 모양하는 수를	
선기도 전혀 된 공작되었어 동속 그에는 눈눈은 수많은 일본도 이 만들어 놓은 동호를 가는 양성이 심었다. 살림은 다른	
하는 소설을 통해 하는 사람이 하는 것도 하는 이를 느껴보지 않는 것 않는데 하다는 사용성도 하는 것이다.	
이 보이 들었다. 나는 아이 그들도 사람들이 되는 사람이 하는 도둑을 보여 하지만 다른 것이다. 나는	
그런 현대생활 나는 아이 바다에는 그 날만 하는 그 모든 사람이 되는 일반 바람들이 되게 받는데 된 것 같	
있는데 용지 마음로 된다. 하는 전 경기 보이 무슨 모든 다음 그는 동안하다고 그만 동안하였다.	
(설명 많이라. Vice Service) 내 시민 전환 이 생활하는 생활하는 경험 등 전환 시작 전환 전환 시민 전환 스포트로이 스	
그리즘 살아보면 살아야 한 것 같아요. 그는 그리면 없는 사람들은 사람들이 있다는 가는 사람들이 가장 살아야 한다. 그는 그는	
크림통학 회에 의하는 소문에 얼마나는 관련 통원들을 하지만 않는데 어떻는 전 된 문장에 되었다고 모나를 모신	
가 있는데 본 등 요즘 돌아나는 그는 말이 되었다면 하는데 나는 사람들이 가지 않는데 되지 않는데 되어 없다고 있다. 그 것	
그렇게 한트로 있으면 이 말한 작가는 이 등로 들어 내고 하는 것이 하는 등 생각이 되는 사람이 되었습니다. 그 가지 만들어 다	
그렇도 화로 시대를 하는 것 같습니다. 생활 경기에 가려왔다면 보지 않는 지수를 받는 지수를 받는 것이다. 나는 사람들이 되었다.	
그 아니를 하다면 나는 아니는 하는데 나는 나는 나를 보면하다니다. 그는 사람이 하나 이렇게 되었다면 하다.	
이 선생이 한다. 이 전 하고, 신청, 너무 살회 나를 하면 하는 것 같습니다. 이 이 이 아는 이 것이 못하고 있다. 그 있는 말하다.	
그렇지 않는 15일 그 10일 보다 이 사실 이 관계를 하게 하지만 보고 있다면 모르는 이 그 그렇지 않는데 그리다.	
하는 한다는 하면 하는 학생들은 일반에 다듬는 일반으로 그렇게 한다는 다른 하는 학생들이 되는 것을 받는 것이다.	
가 그렇게 되었다. 이번 사는 회사 가는 점을 환경하실 하는 그리는 사람들이 하는 사람들이 가지 않는데 하다 되었다.	
그리는 그의 전 경우 하는 장은 사이가 전환 눈이 작용하고 눈면한 시간한 논문이가 가면 안 되어 가는 보다가 되었다.	
소식으로 한 문문, 경기 불편된 강화 소리에는 보고 있었다면서 관련되었다. 경기는 사람들이 그리고 하는데 나를 받는 듯했다.	
그일 하는 사람들은 아들로 성격을 받았다. 항상 전에 마음한 것이 들어들고 하는 것 하나 하고 있을 것이 되었다. 전상 점점	
다른 문화를 하신 듯했다. 그리는 학교의 원칙 시간 전화로 시험 전환 한 사람은 사람들이 모르는 때문 되었다.	
경기가 있다. 사람들이 많아 되었다. 사람들의 하일에 가는 그릇이 하면 하면 나는 의 문에서 나를 가득하다.	
문문하다. 하는 사람들은 사람들은 사람들은 하는 사람들이 사람들이 되었다. 살아 없는 것이 되었다.	
선생님은 이 이 나는 사람들은 물리 가는 살이 보고 나를 가지고 있다. 그는 사람들은 그들은 그들은 그들은 그는 사람들은 그를 가는 것이다.	
· 회사보다 함께 하는 사람이 가는 사람이 되는 사람이 하는 사람이 되는 것이 되는 것이 되는 것이 없는 것이다.	
· 통해 회의통한 클로프린티, 이글 사용된 아들이 독립하는 항상 나는 아니는 아니는 이나는 이나는 하는 가족 아름답니다.	
· 경험 교통하는 특별 시간 사람들은 물리에 한다고 하는 사람들이 들고 있는 사람이 되고 있다. 그 사람들은 말하는 것이 없는 것이다.	
· 홍현 경영 경영 등 전기에 보는 말을 보면 제 한 경이 되었습니다. 그는 그는 그는 그는 그는 그를 가고 있었습니다. 	

## APPENDIX III - 1 RESERVE ESTIMATING PROCEDURE

## 1-1 Volumetric Calculations

Reserves have been calculated by either or both of two methods, the probabilistic and the conventional.

Probabilistic calculations have been made using the computer program. The program requires probabilistic distributions, type and quantifying parameters for all input parameters used in reserve calculations (except for the chance factor, which is single-valued).

For distributions where no minimum and maximum exists, values of four times the standard deviation on either side of the mean are used. These parameters are retained throughout the calculation of fluids in place and ultimate recoveries. The final distributions are represented by beta functions, which are integrated to find the percentile points of the expectation curves.

The conventional reserve calculations have been made using the computer program PISC. Fluids in place are calculated using single-valued volumetric parameters and uncertainty is allowed for by assigning a single-valued probability for the existence of the fluids. Reserves may then be estimated by multiplying the fluids in place by a recovery factor or alternatively by extrapolating reservoir performance. Part of these reserves which are related to seen fluids combined with a recovery factor which has a high probability of achievement are designated "proven". Unproven reserves are related to unproven fluids in place and/or to uncertainty in recovery factor. Therefore the apparent recovery factor may be physically meaningless if, for example, the unproven reserve results from uncertainty in recovery factor.

To obtain an "Expectation Curve" for ultimate recoveries calculated by conventional means, a normal distribution is fitted through the proven U.R. (= 95%) and the expectation (= 50%).

### 1-2 Definitions

**Expectation Curve:** 

is a plot of the estimated probability that a certain volume or more of hydrocarbons will be recoverable versus that volume of hydrocarbons.

Expectation of Reserve:

represents the volume of hydrocarbons which is thought to be technically and economically recoverable.

It is equal to the area under the expectation curve.

If the reserves are proportioned into a proven part and an unproven part, the expectation of reserve is taken as the sum of the proven and discounted unproven part.

High Estimate of Reserve:

is the quantity of reserve which has a 15% cumulative probability of being recovered.

Low Estimate of Reserve:

is the quantity of reserve which has a 85% cumulative probability of being recovered.

Possible Reserve:

is the reserve which is supported by favourable engineering and geological data but which is subject to some element of risk which prevents classification as Proven Reserve.

Proven Reserve:

is the quantity of hydrocarbons which geological and engineering data demonstrate with reasonable certainty (say 95%) to be recoverable in the future under existing economic and operating conditions. It represents strictly technical judgements, and is not knowingly influenced by attitudes of conservatism or optimism.

# APPENDIX IV

- 역간한 문학 상황들께 다시 역상 문학 시간 시간 수는 학교는 이 글로 하는 사이트 전 보이고 있다.	
	and the se
그리고 말으면 그림에 보는 내용하다 하는 사람이 있고 있는 이번에 되고 있는데 이번 이 없었다.	
공사하다 하다는 하다 하는 얼마를 하고 있다. 그는 그들은 그들은 그들은 그들은 그들은 그는 것이라고	
마까 보고 말을 되었는데, 그리고 있는 소리가 들고 말을 하는데 하는데 말하다고 있는데 말을 하는요.	
그는 가루를 하는 것은 경험을 하는 것은 것은 것은 사람들이 보고 있는 것을 다른 것은 것을 다 했다.	
그를 돌고를 통합하고 하면 등 시골에 되었습니다. 그는 이 이 보고 하는 것은 그를 하고 있는 것이 없었다.	
이 날만 동안 되었다. 이번 속에 이어난 이 이 동안 이 집에 이 모든 이 집에 들면 말을 하는데 되었다. 모든 모든 모든	
그를 되어왔는데, 한 번째 마리 아이들은 그리고 있는데 그리고 있는데 그리고 있다고 있다. 그는데 그리고 있다고 있다.	
그 병원 호텔은 얼마 집에 다른 어디를 하면 하는데 그는 이번 이번 나는 모든 그를 통해 그릇을 하다 한다면서	
그게 하면 내가 말으셨는데 하는데 하셨다. 하는데 이번 그는 나는데 나를 되고 있었다. 그는 그리다	
그 사람들이 하는 사람들이 많아 있다면 하는 하는 사람들이 다른 사람들이 살아 있다.	
그렇게 맞고한다 한다면 회사회의 모든 이번 모르게 하네지 하나는 아버지는데 어느를 잃었다.	
그렇게 하는 사람들은 사람이 나는 살아들이 되었다. 그는 사람이 되는 사람이 되었다. 그는 사람들은 살아 그렇게 되었다.	
이용 방문을 지내는 일본을 모고 있는 것으로 그렇게 되는 것으로 하는 것이 들었다. 그런 것 같은 사람들이 없는 것이다.	
,我们的 <b>她</b> 就想到她的意思,只是一个大概的,我们的说法,我们就是一个大小的,我们就是一个大小的,我们就是一个大小的,我们就是一个大小的,我们就是一个大小的,我们	
이렇게 하는 바꾸 것이라 없는 사람들에 동생하게 동생하는 경험을 가는 가는 입하다. 그렇게 있는	
존대하고 말로 프로그램 그리다. 그는 이름 말을 잃고 하다 하면 하는 이 사람들이 모든 그를 모든 것을 보니 하는 것을	
그리고 마른 병원 회원을 발표했다. 그 무실하다는 그 그 이번 일본 부분들도 보고 얼마 되었다. 한번	
그림을 하겠다. 그런 방마는 그는 맛이 그는 사람들은 하면 하는 그 그들은 하다. 그는 내 없는 그는 바다 그는 사람이 되었다.	orto substitution de la constitución de la constitu
이 화살하지 않는 바다가 나는 아이들이 있다면 하지 않는 것 같은 사람들이 하는 것 같은 사람들이 다른 사람들이 되었다.	
그들이 있다. 그 나를 하는데 이 바로를 보고 있다. 그리는 이 불워 걸어 하면 그들에 다른데 하다.	
고 있으면 하는 사람들이 사용하는 현실을 당했다. 그리고 있다는 사람들은 사람들이 모르는 사람들은 현실이 하고 있다는 것이다. 	
그리다. 그는 이 전환에 되는 이 사람들은 경기에 가는 하는 그를 마하는 다른 모두 가고 하는 것은	n en jaran. Najaran
그 나타를 하는 사용 대체 교육을 했다면 그리는 하는 것은 사람들이 되는 하는 하는데 되었다.	
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- 프로젝트	
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# APPENDIX IV-1 PRELIMINARY INVESTIGATION OF ADEQUACY OF THE STORAGE CAPACITY OF THE PROJECTED DAM

## 1-1 General

To satisfy the increasing demand for water in the Bintulu area, PWD is proceeding with a project to construct a pumped storage dam having water storage capacity of 350 million gallons (1.6 million m³) with a catchment area of 100 acres, which is located on the basin of the Sika river, a tributary of the Sungai Sibiu river.

In order to justify the adequacy of the dam capacity, the following two points should be satisfied in particular:

- (1) Whether the dam is capable of impounding a sufficient volume of water for storage, in view of the rainfall and topography in the dam area.
- (2) Whether the designed storage capacity (350 million gallons) of the dam is adequate to supply a sufficient volume of water during a dry season.

Regarding the point (1) above, it is deemed to be satisfactory, because the dam is to store the water pumped up from the Sibiu river when the river is at a high level. Therefore, the investigation is concentrated on the point (2). It must be noted, however, that this investigation is preliminary in nature, because detailed data needed for detailed investigation will not be available until completion of investigation of soil and subsoil conditions of the dam area. This latter investigation is now being performed by Halcrow Balfour Ltd., a British consultant, for developing the bases for detailed design of the dam.

Steps taken for this investigation are shown in the flow chart in Fig. AIV-1. In accordance with the given steps, the requirements for water to be stored in the dam in order to ensure sufficient volume of discharge (V) was first calculated, and then compared with the designed storage capacity of the dam (350 million gallons). If the designed dam capacity is larger than the thus-estimated requirement (V), it is judged that the dam has adequate water supply capacity.

## 1-2 Method of Calculating the Requirements for Water to be Stored in the Dam (V)

As is stated earlier, water to be stored in the dam will be primarily from the Sika river, but because the water of this river is not sufficient, additional volume of water will be pumped up from the Sungai Sibiu. Since the water impounded by the dam is to be kept at the required level by means of pumping up the river water, to the extent that water is discharged from the dam, as far as the water flow of the Sika river and Sibiu river remains at a rate over the required discharge from the dam, there is no deficit in the water of the dam to discharge. The stream of Sika river flows into the Sibiu river, and therefore the water flow volume of the Sibiu river downstream from where the Sika river enters, is deemed to be the total volume of water flow of both rivers.

In this context, it can be said that the storage capacity of the dam should not be less than that corresponding to the aggregated annual volume of present water flow of the Sibiu river which is in deficit in relation to the required discharge from the dam. Therefore, as an approach to this investigation, the required volume of water to be stored in the dam can be calculated by means of estimating such an aggregated annual deficit in the water flow of the river, below that needed by the dam in order to hope the required discharge rate.

Thus, the requirements for water to be stored in the dam (V) were calculated by using the following formula:

$$V = \frac{Qr - Qn}{2} \times D$$

Where,

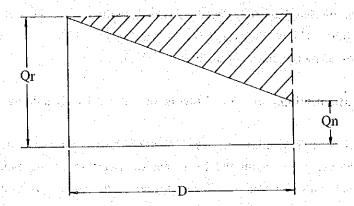
Qr: Rate of water flow in the Sibiu river which is required for water supply to the dam to meet requirements for discharging from the dam.

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Qn: Probability rate of minimum daily water flow in the Sibiu river in a period of "n" years.

D: Maximum number of days during which the water flow rate of the river is below the required rate.

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It is assumed here that the daily volume of make-up water which is pumped up from the Sungai Sibiu, would decrease to the extent that the water flow volume of the river decreases, and such decrease (from "Qr" to "Qn" in the above picture) would be in a linear form. It is derived from the changes in the water level of the Sungai Sibiu which shows a nearly linear trend when the river flow is at a low level (see Fig. AIV-2).

## 1-3 Hydrological Data Used

Hydrological data used for this study are as follows:

1) Record of water level in the Sungai Sibiu (recorded by one measurement every day)

Period of the record:

8 years (1969 - 1976)

2) Record of daily rainfall

Period of the record:

12 years (1967 - 1978)

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1-4 Estimation of the Rate of Water Flow in the Sungai Sibiu which is Required for Water Supply to the Dam to Meet Requirements for Discharging from the Dam (Qr)

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Volume of water to be discharged from the dam is first estimated so as to meet the water demand of the Bintulu area (14.5 million gallons; 0.767 m<sup>3</sup>/sec.), projected by PWD. Assuming that the extent of water intake from the Sungai Sibiu is 90% of the river flow volume, the rate of water flow in the Sungai Sibiu which is required for water supply to the dam to meet

the requirements for discharging from the dam (Qr) is estimated to be 0.852 m<sup>3</sup>/sec. (0.767 m<sup>3</sup>/sec. divided by 0.9). The water level of the river at this required water flow rate is estimated as 0.76 m (2.53 ft) by using the chart shown in Fig. AIV-3.

## 1-5 Probability Rate of Minimum Water Flow in the Sibiu River in a Period of "n" Years (Qn)

Probability rates of minimum water flow of the river in the respective periods of 5, 10, 20, 50 and 100 years are estimated by means of ascertaining the cumulative frequency distribution of data showing the minimum for each year in the past record of daily water flow of the river, plotting the data on a log probability sheet and joining the plotted points by closest straight line possible (see Fig. AIV-4). The results are as shown below.

No.	Month and Year of Occurrence		nimum Daily Water Flow Rate (m³/sec.)			$\frac{n}{N+1} \times 100$ (%)	
1	3/1970	. 2.	2.30		13		
2	7/1975	1.	1.54		25		
3	2/1969	1.	1.05		38		
4	7/1972	0.	0.82		50		
5	6/1974	0	0.62		63		
6	8/1976	0	0.47		75		
7	2/1973	0.40		***	88		
					(n =	7)	
Period of Years: N =		5	10	20	50	100	
Probability Rate of Minimum Water Flow (m³/sec.)			0.32	0.23	0.17	0.13	

# 1-6 Estimation of Maximum Number of Days during which the Water Flow Rate of the River is below the Required Rate (D)

Maximum number of days during which the water flow rate of the river is below the required rate (D) is estimated in two ways; one estimation using water level data (as stated in 1-6-1) and another using rainfall data (as stated in 1-6-2). The thus-estimated "D" is 40 days in the case of the former way, and 45 days in the case of the latter, so 45 days is used as the basis.

## 1-6-1 Estimation using water level data

The number of days each year when the water level of the river was less than that required was counted, using the past record of the river water level.

This number of days counted is shown below.

Year	1969	1970	1971	1972	1973	1974	1975	1976
No. of days	0	0	-	-	23	. <b>7</b>	0	32

The maximum number of days during which the water flow rate of the river is below the required rate (D) was determined by adding 20%, as a safety factor, to the counted number of days. Thus, estimated (D) is 40 days (32 days x 1.2).

## 1-6-2 Estimation using rainfall data

It is a well-known theory that decrease in water flowing in a river from a certain catchment area, which takes place in the event there is a number of rainless days following a rainfall, would make a trend at a certain rate of curvature. By applying this theory, the "number of days in which the rate of river water flow decreases to a certain rate" (D-1) and "number of days during which the rate of river water flow is below the certain rate" (D-2) are estimated.

The "D-1" was first estimated for the catchment area of the Sibiu river by using data given in Fig. AIV-5. The results show the following two typical patterns regarding the "D-1":

- (a) In the event when there is a rainfall after a long period of rainless days, and after the rainfall there is a long period of rainless days again: D-1 of 6 days.
- (b) In the event when there is a rainfall after a short period of rainless days, and after the rainfall there is another period of rainless days:

  D-1 of 13 days.

By using the thus-estimated "D-1" and rainfall data for each year, the "D-2" for each year was estimated. The results are as shown below.

in die	Year	No. of Days
	1967	3
	1968	2
	1969	17
	1970	12
* *	1971	21 .
	1972	35
	1973	24
	1974	13
	1975	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
	1976	19 (19 19 19 19 19 19 <b>27</b> 5) (19 19 19 19
	1977	10 - 10 - 10 - 10 - 10 - 10 - 11 - 10 - 1
	1978	0

The maximum number of days during which the water flow rate of the Sibiu river is below the required rate (D) was determined by adding 20%, as a safety factor, to the maximum of the above estimated "D-2". Thus, estimated (D) is 45 days (35 days x 1.2).

## 1-7 Result of Investigation

The "V" was calculated on the basis of "Qr", "Qn", and "D" estimated above and by using the calculation formula given in 1-2. The following table shows the thus-estimated "V" and a safety ratio of the storage capacity of the projected dam against the "V". (For this comparison, the dam capacity was based on an effective storage capacity which was determined as 90% of the designed storage capacity of the dam. The designed storage capacity is 350 million gallons (1,591,000 m<sup>3</sup>). Thus, the effective storage capacity is: 1,591,000 m<sup>3</sup> x 0.9 = 1,431,900 m<sup>3</sup>.)

The following comparison indicates that the capacity of the dam would have a safety ratio of 1.02 against the requirements for water to be stored in the dam which was estimated even with a probability period of 100 years, and hence it is believed that the designed storage capacity of 350 million gallons is satisfactory for meeting requirements.

	N	Qn (m³/sec.)	Qr (m³/sec.)	D (days)	V (m³)	Safety Ratio of Dam Capacity against "V"	
٠,	<del></del> -						
	5	0.45			781,500	1.83	
1	10	0.32			1,034,200	1.38	
	20	0.23	0.852	45	1,209,200	1.18	
	50	0.17			1,325,800	1.08	
i'	100	0.13			1,403,600	1.02	

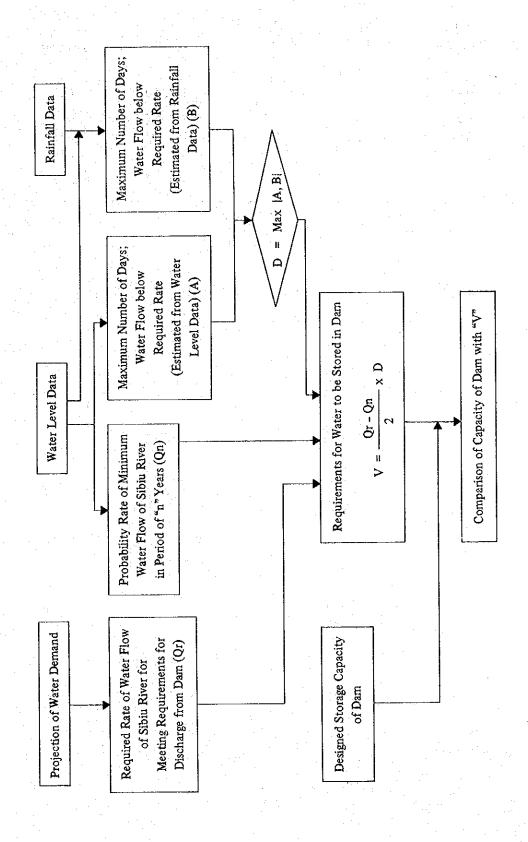
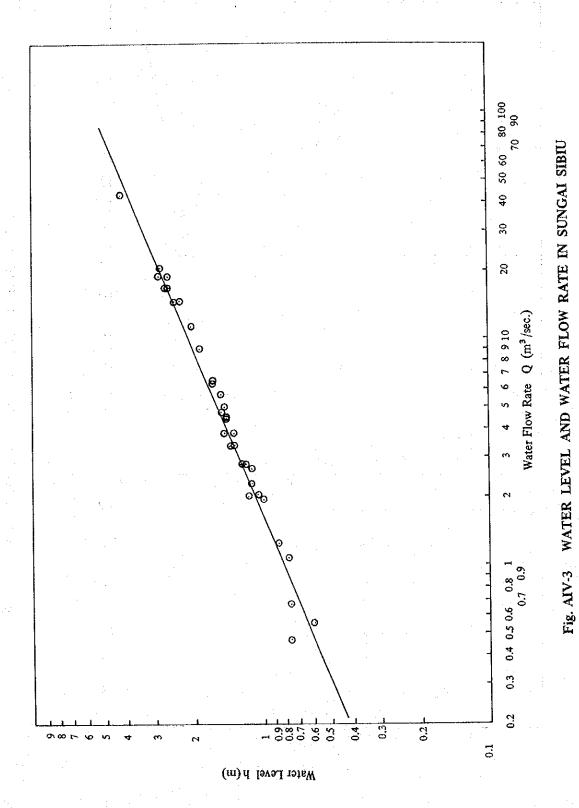


Fig. AIV-1 FLOW CHART SHOWING STEPS FOR PRELIMINARY INVESTIGATION OF DAM CAPACITY

Fig. AIV-2 DAILY WATER LEVEL IN SUNGAI SIBIU IN 1974

Days



**AIV**210

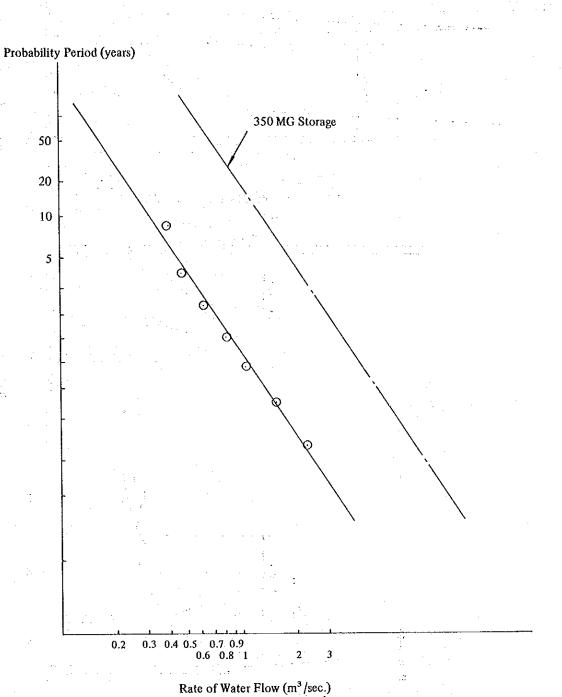


Fig. AIV-4 PROBABILITY RATE OF MINIMUM WATER FLOW IN SUNGAI SIBIU IN PERIOD OF "N" YEARS

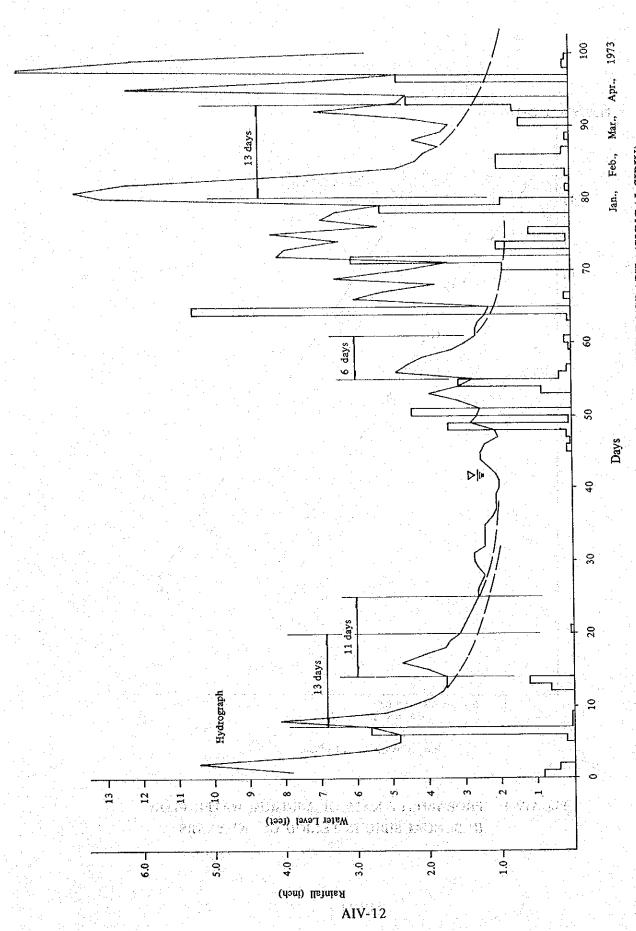


Fig. AIV-5 DAILY CHANGE IN RAINFALL AND HYDROGRAPH (SUNGAI SIBIU)

## APPENDIX IV-2 INVESTIGATION ON AVAILABILITY OF PORT FACILITIES

## 2-1 Possible Occupancy Rates of Bulk Cargo Pier

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#### 2-1-1 Method of investigation

The steps commonly used for investigation of the rates of possible occupancy of piers are shown in a flow chart in Fig. AIV-6. According to the given steps, investigation is made of these rates for the Bulk Cargo Pier of the projected Bintulu Deepwater Port which is to be used for shipment of products from the Ammonia and Urea Complex.

The determinants of these rates are the volume of cargo handled, the number of piers used, the working efficiency for cargo handling operation, and the duration of time for the piers to be occupied by ships. For the investigation of occupancy rates for the Bulk Cargo Pier, of the determinant factors mentioned above, the working efficiency for cargo handling operation at the pier was estimated by using available data in respect of meteorologic and oceanographic conditions in the Bintulu Deepwater Port area, since it was believed that by using this method the estimation could be made at a satisfactory level. Regarding the duration of time for the pier to be occupied by ships, however, because there is no record at the present time, a standard rate in Japan, which had been estimated by referring to past records in Japanese ports, was applied.

The investigation was made on the assumption that only the Bulk Cargo Pier would be used for the shipment of products from the Complex.

## 2-1-2 Conditions of operation and assumed conditions

#### (1) Conditions of operation

#### (a) Annual volume handled (A)

On the basis of 330 days per year of plant operation, and further assuming that the output will be 90% of the plant capacity, the annual volume of products produced at the Complex and handled through the pier is assumed to be:

Urea:

 $1,500 \text{ t/d} \times 330 \text{ days} \times 0.9 = 445,500 \text{ t/y}$ 

Ammonia:

 $130 \text{ t/d} \times 330 \text{ days} \times 0.9 = 38,610 \text{ t/y}$ 

### (b) Type of vessel (B)

The vessels used are to be 7,500 to 10,000 tons ships for urea, and 400 to 1,500 tons ships for ammonia.

#### (c) Port calls (C)

Annual port calls would be as shown in Table AIV-1.

Table AIV-1 ANNUAL NUMBER OF CALLS FOR EACH VESSEL

and the second of the second o		
Cargo	Vessei	No. of Calls per Year*
Urea	10,000 tons	45
hy conjugation is a rejection	7,500 tons	
Barrier a referencial consistent	ar a wayya dalar .	of Jan 19 1 The State of the 19
Ammonia	1,500 tons 400 tons	26 9 <b>7</b>

<sup>(\*:</sup> Determined by dividing volume of product by vessel capacity.)

## (2) Other assumptions

## (a) Annual number of days pier could be used (H)

The number of days per year that the pier could be used is greatly influenced by such factors as wind and wave conditions, visibility, etc. Conditions at the pier are quite calm as there are almost no days during the year when the hourly mean wind velocity exceeds 8 m/sec. The wind is mainly from the southwest from May to September, and from the northeast from November to April; the winds from the northeast are stronger than those from the southwest. However, the harbor's breakwater has been planned to provide protection from the northeast. The pier is to be located inside of both the Outer Breakwater and Inner Breakwater, where the average wave height is

low as 0.34 m (NORCONSULT, May, 1976) and would not adversely influence the movements of tugs or performance of loading activities. Visibility is good throughout the year and on an annual basis visibility of less than 2 miles (3.2 km) occurs with a frequency of less than 1.7%. On the basis of these conditions, it is judged that the pier can be used during  $70 \sim 80\%$  of the calendar year, and hence this range of figures has been used in the present investigation (in the NORCONSULT Report, the visibility was estimated to be 70%).

## (b) Number of working days per daylight day (I)

On an annual basis, assuming that work could be performed for 11 hours each daylight day, the number of working days per calendar day is:

#### 11 hours/24 hours = 0.46 days

## (c) Net number of days at pier per call (D)

The duration of pier occupancy by a ship is generally measured as the gross hours from mooring to casting off of ship after loading or unloading.

The net number of days at the pier per call for each type of cargo and size of ship is as shown in Table AIV-2. In performing the calculation for preparation of the data given in this table, it was assumed that loading would be performed during the daytime.

## 2-1-3 Results of investigation

The possible pier occupancy rate, annual number of days the pier could be used, and the annual number of days for pier occupancy, as estimated on the basis of the above operating conditions and according to the flow chart, are shown in Fig. AIV-7, and Tables AIV-3 and AIV-4.

As is clear from the figure and tables, the rate of possible pier occupancy is within the range of  $50\% \sim 63\%$ . In port planning work in Japan, the rate of possible pier use of  $60 \sim 70\%$  is generally used. Judging from this, when cargo loading is done during the daytime only, even though the pier would have some unused capacity, it would be

Table AIV-2 NET NUMBER OF DAYS OF PIER OCCUPANCY PER CALL

								:						
	æ	10,000 Tons Vessel	10,000 t	600 t/h	450 t/h	1.0	0.5	22.3	0.5	0.5	24.8	25.0	25/11 = 2.27	
PER CALL	Urea	7,500 Tons Vessel	7,500 t	600 t/h	450 t/h	1.0	0.5	16.7	0.5	0.5	19.2	19.5	19.5/11 = 1.77	
ER OF DAYS OF PIER OCCUPANCY PER CALL	Ammonia	1,500 Tons Vessel	1,500 t	100 t/h	90 t/h	0.5	0.3	16.7	6.3	0.5	18.3	18.5	18.5/11.0 = 1.68	
ER OF DAYS OF	Amr	400 Tons Vessel	400 t	100 t/h	90 t/h	03	03	<b>4.4</b>	0.3	0.3	9'\$	0'9	6.0/11.0 = 0.55	
Table AIV-2 NET NUMBI				<b>A1</b>	g capacity	Arrival, mooring	Hook-up cargo handling equipment	Loading	Remove cargo handling equipment	Lift anchor, depart	Sub-total	Net pier occupancy period per call (hours)	Net pier occupancy period per call (working day)	
			Full-load volume	Cargo handling capacity	Actual cargo handling capacity	Control Contro	AIV-1	Duration of use of	pier (hours)			Net pier occupancy p	Net pier occupancy r	

necessary for the pier to be available for the exclusive-use for loading products of this Project.

Table AIV-3 POSSIBLE PIER OCCUPANCY RATE BY SIZE OF VESSEL

				and the second s	
	Amn	nonia	Urea		
Size of Vessel	400 tons	1,500 tons	7,500 tons	10,000 tons	
Number of days of pier occupancy	and we have		Web miles		
per call (Do)	0.55 days	1.68 days	1.77 days	2.27 days '	
Annual number of days of pier occupancy (D <sub>L</sub> )	54 days	44 days	107 days	113 days	
Possible pier oc- H = 256 days cupancy rate H = 292 days	21 % 18 %	17 % 15 %	42 % 37 %	40 % 35 %	

Table AIV-4 POSSIBLE PIER UTILIZATION RATE BY COMBINATION OF VESSELS

Combination of Vessels	Ammonia Urea	1,500 tons 10,000 tons	1,500 tons 7,500 tons	400 tons 10,000 tons	400 tons 7,500 tons
D <sub>L</sub> (days)		147	151	157	161
Possible pier oc- H = 256 days		57 %	59 <b>%</b>	61 %	63 %
cupancy rate H = 292 days		50 %	52 %	54 %	55 %

## 2-2 Requirements for Cargo Handling Facilities

It is necessary for the cargo handling facilities to be used for this Project to have the the following characteristics.

## (a) Annual volume of shipments

Bulk urea:	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	495,000 t/y
Liquid ammonia:		42,900 t/y

(b) Vessels using pier

Bulk carriers:

7,500 to 10,000 tons

Tankers:

400 to 1,500 tons

(c) Required draught:

10 m

The ancillary facilities which must be provided in conjunction with the above are as

(a) Loading equipment

follows:

Bulk loader:

Rated capacity;

600 t/h

Working capacity;

450 t/h

Liquid loader:

Rated capacity;

100 t/h

Working capacity;

90 t/h

- (b) Tugboats
- (c) Channel markers
- (d) Telecommunications facility

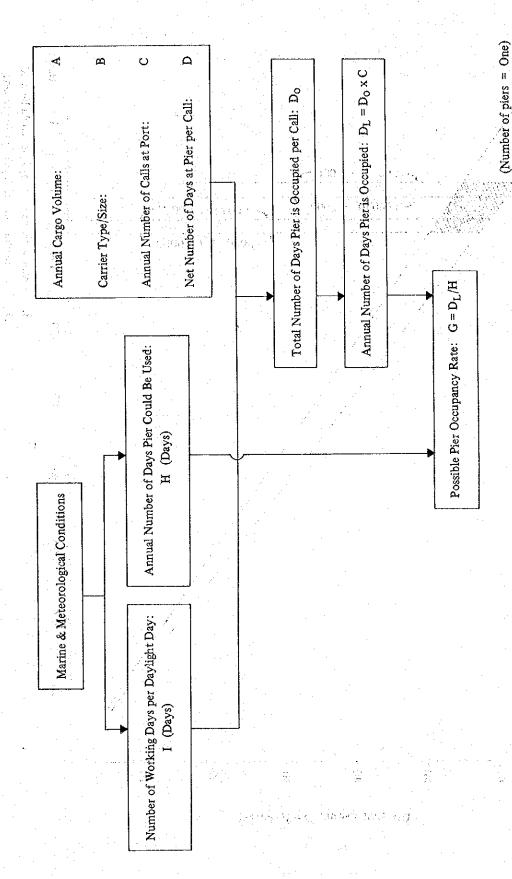


Fig. AIV-6 FLOW CHART FOR STUDY OF PIER OCCUPANCY RATE

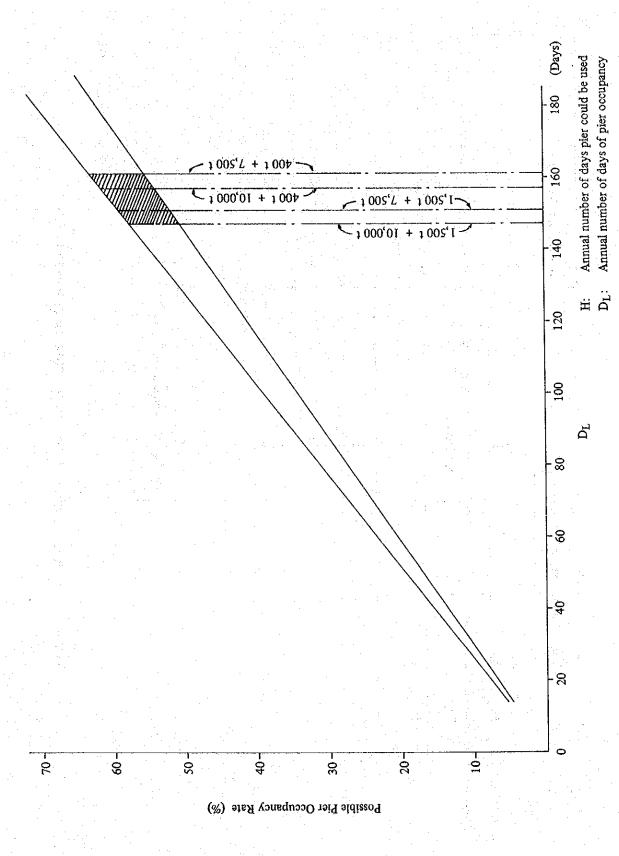


Fig. AIV-7 RELATIONSHIP OF POSSIBLE PIER OCCUPANCY RATE, H AND DL

## APPENDIX IV-3 AMMONIA AND UREA FACILITIES

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The ammonia and urea plants are the heart of the Complex. In view of the scale of production capacity and product quality, these plants planned for this Project, as described in Part IV, are a standard type of one-train plants; a number of similar type of ammonia and urea plants have recently been built in various part of the world. Although steady progress is being made in improvement of ammonia and urea manufacturing processes applied to those plants, and in plant performance and reliability, fundamentally the basic technology has been standardized, and as long as the plants are built on the basis of the know-how of a highly reputed process owner, and are built by a highly reputed engineering contractor, a high degree of reliability may be expected. There are a number of engineering contractors which are capable of undertaking the work. Even though there will be variations in details of plant design made from company to company, the technological and economic differences between them are not so great, so it is suitable to make a process evaluation and selection in a precise manner at the stage of selecting a contractor who undertakes the design, engineering, procurement and construction of these plants.

In this context, the following description is given as one example of typical processes, but it does not suggest or recommend any specific process.

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# (1) Ammonia production facilities

A typical flow sheet for ammonia manufacturing process is provided as Fig. AIV-8.

The natural gas which is supplied at the Complex fence is divided into two flows after metering, one flow is to supply gas to be used as feedstock, and the other to supply gas to be used as fuel at the primary reformer of the ammonia plant and the steam boiler facility.

Natural gas to be used as feedstock, after removal of sulphur compounds and carbon dioxide, is preheated, mixed with steam, and introduced to the tube of the primary reformer, in which under catalyst, hydrocarbons in the fed gas are reformed to yield synthesis gas consisting mainly of hydrogen, carbon monoxide and carbon dioxide. The reformed gas is mixed with air and introduced to the secondary reformer where unreacted hydrocarbons are oxidized to produce gas composed of hydrogen, carbon monoxide and carbon dioxide.

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Secondary reformer gas is passed through shift converters where carbon monoxide in the gas is converted to hydrogen and carbon dioxide; carbon dioxide is removed and then, by means of methanation, residual carbon dioxide and carbon monoxide are converted to inerts and a synthesis gas with the mol ratio of hydrogen-to-nitrogen of 3: 1 is produced. The synthesis gas is compressed and fed to an ammonia reactor charged with catalyst in which the ammonia synthesis reaction takes place. Ammonia in the reaction gas is separated by cooling and is recovered as liquid ammonia while unreacted gas is recycled and sent to the reactor to produce ammonia. The thus-produced ammonia is stored in tanks prior to loading for the shipment, while it is supplied to a urea plant.

#### (2) Urea production facilities

A typical process flow sheet for urea manufacturing process is shown as Fig. AIV-9.

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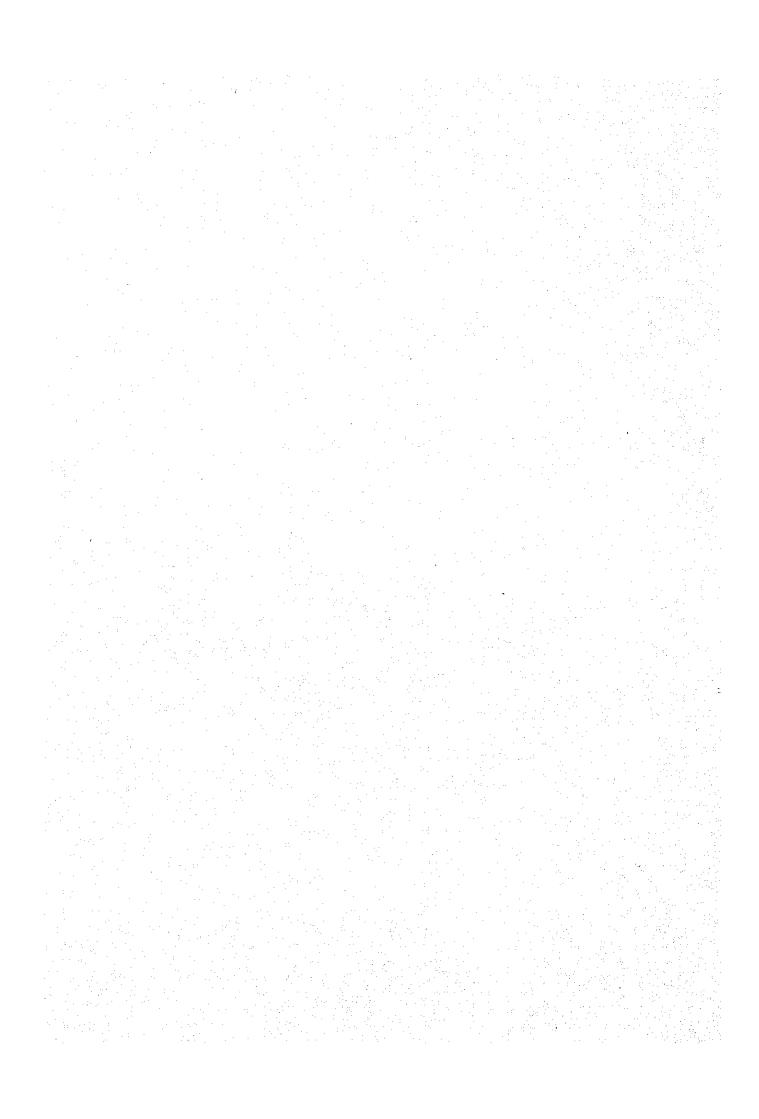
From liquid ammonia and carbon dioxide removed out in the process of manufacturing ammonia, urea is produced through ammonium carbamate formation which is achieved under conditions of high temperature and pressure in a reactor. The reactions in the reactor are between ammonia, carbon dioxide, ammonium carbamate and water to form urea and by reducing the pressure, stripping and increasing the temperature downstream from the reactor, the residual ammonium carbamate is decomposed into ammonia and carbon dioxide, and urea solution is obtained.

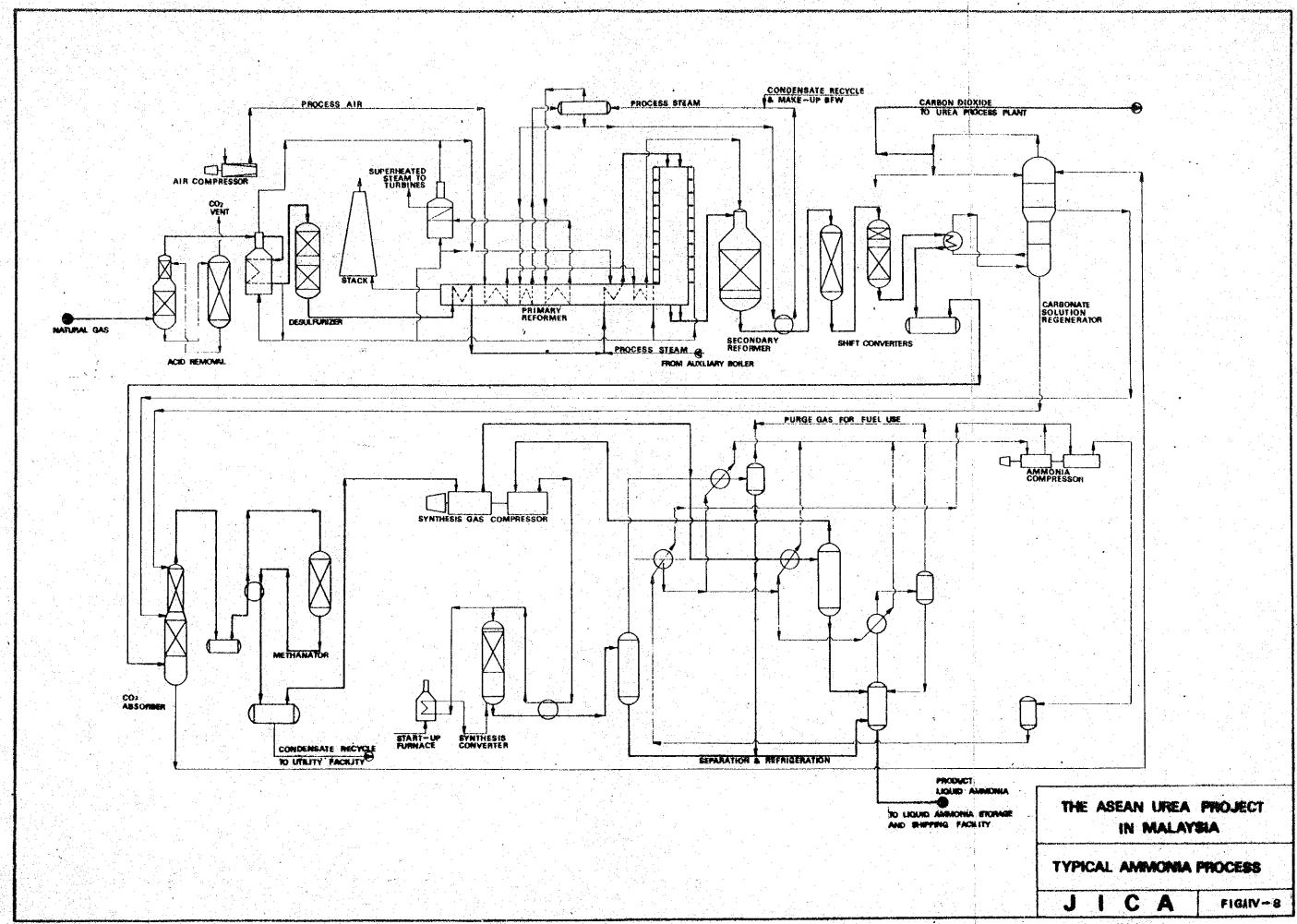
A crystallizer is used to obtain crystal urea from the urea solution and the urea crystals are separated by use of a centrifuge and then dried, melted and prilled at the prilling tower. The prilled urea product is conveyed to a bulk storage warehouse for temporary storage prior to being shipped in bulk.

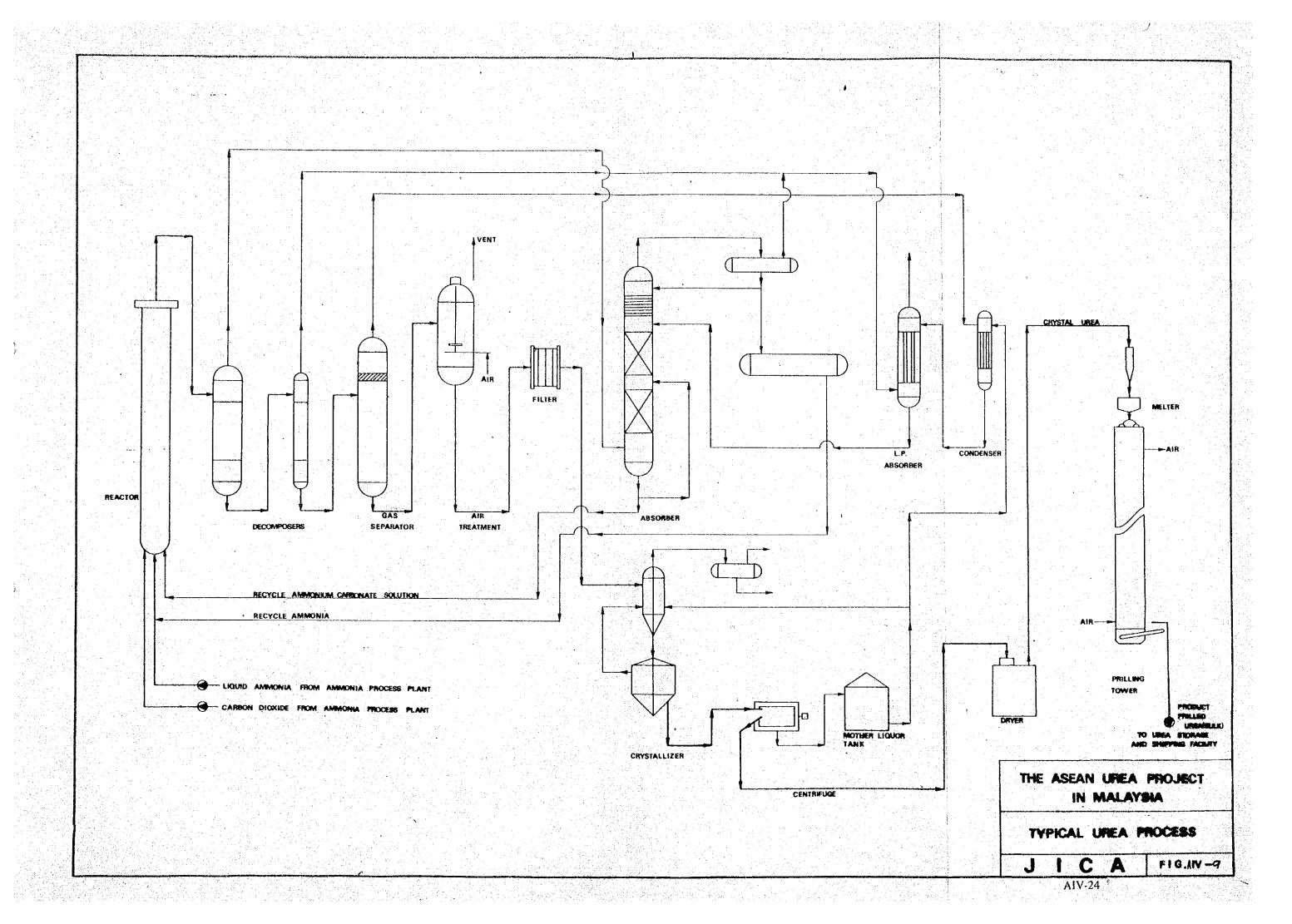
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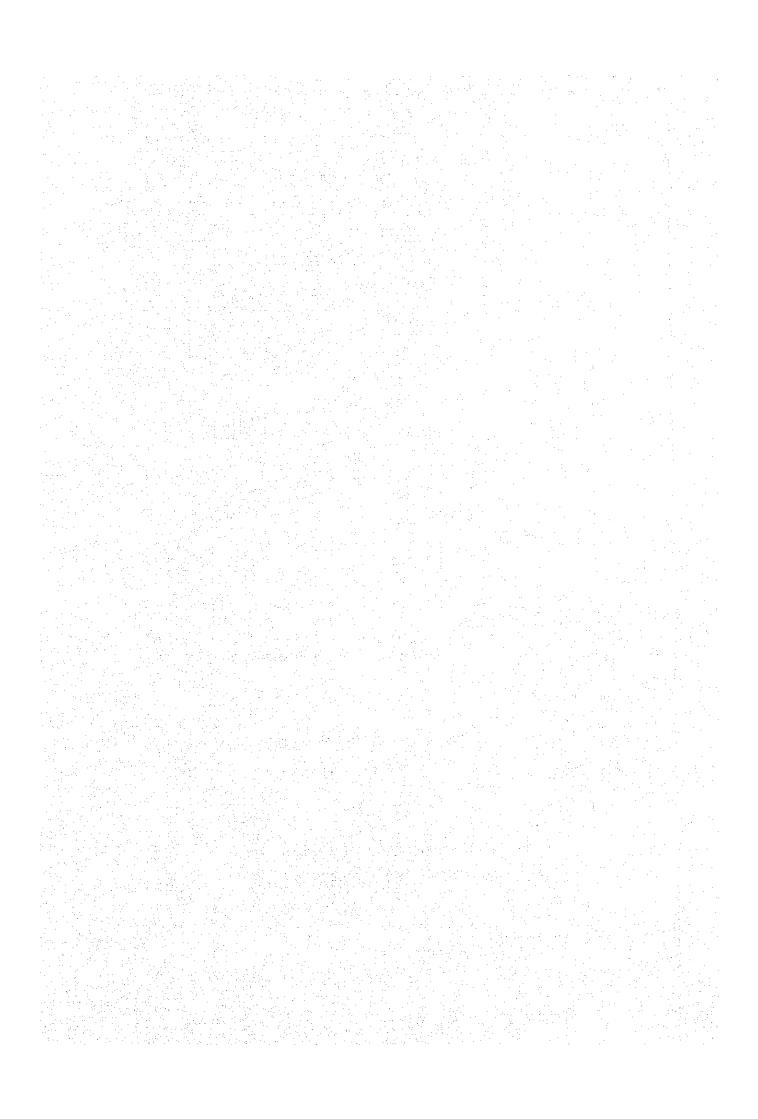
Ammonia and carbon dioxide which have been recovered at the preceding process and urea solution containing a high biuret concentration recovered are recycled and fed to the urea reactor with freshly fed ammonia and carbon dioxide.

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#### APPENDIX IV-4 SITE PREPARATION

## 4-1 Present Conditions

## 4-1-1 Topography

The proposed Complex site is in an elevated area in the southern part of the Kidurong peninsula. The northern boundary follows an east-west ridge which is at elevations of  $60 \sim 70$  m, and the southern boundary follows the Tg. Kidurong road which is at the elevation of 12 m. Therefore the site's northern and east-west boundaries are at higher elevations, and there are strong undulations spreading in a generally southern direction. The site is about 40 ha in area.

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The site is divided into three parts by two marshes which are oriented eastwest. The marshes form small swamps in low areas near the Kidurong road.

#### 4-1-2 Soil

Because no boring logs are available for land within the site, it is not possible to make a reliable judgement, but the following observations may be made on the basis of the geological maps published by Malaysia's Geological Survey, soil data for Bintulu Deepwater Port, and field reconnaissance of site preparation work underway for the LNG plant.

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The ground is covered by a thin stratum (0.2 to 0.3 m) of topsoil which contains considerable organic matter, below which is a stratum (3 to 4 m) of sandy silt (so-called tropical laterite). Below that is Neogene sedimentary sandstone and shale.

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## 4-1-3 Vegetation

With the exceptions of the swamps and marshes, most of the site is covered by a dense growth of young broadleafed trees and undergrowth which is about 2 m in height. Most of the trees within the site are slender and tall.

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### 4-2 Preconditions for Site Preparation

For this Project, planning for preparation of the site is worked out in consideration of the topography and soil conditions of the site area and with the objective of drawing the optimum site plan which requires the least costs for site preparation work, while satisfying other conditions, that is, (a) the finished grade of the site would be as flat as feasible, and (b) the site would facilitate the carrying-in of heavy goods and long-measure equipment.

In this context, the following was set as preconditions for examination of the site preparation plan:

## (1) Conditions provided for moving of equipment to the site

In order to facilitate moving of heavy goods and long-measure equipment to the site, the grade of the access road from the Tg. Kidurong road to the site should be no more than 5%, and curves should have ample radii.

### (2) Conditions concerning the site

The area required for the Complex, not including provision for future expansion, is to be 150,000 m<sup>2</sup>. The site area should be flat to the maximum extent possible.

#### 4-3 Case Studies

The important step in examining the site preparation plan is to select the most economical one, among several alternatives, regarding the finished form and level of the site which would satisfy the conditions stated in 4-2 above. It is a general practice for engineering of site preparation how to draw the plan by which the volume of earth to be cut and filled could be balanced to the greatest extent possible, and earthmoving would be minimized. In the case of this site, however, because there is a limited space of flat land due to the strong undulation of the land and steep gradient, a site preparation plan designed to obtain a balance of the volume of earth for cutting and filling would result in the finished grade being considerably above the elevation of the road.

In view of the above characteristics, a few alternative plans were prepared, on the basis that difference between the elevations of the road and finished grade of the site is kept at about 15 m in order to keep the slope of the access road at no more than 5%, and among these

alternative plans, a plan which could attain least volume of earthwork was selected as the recommendable one. The process of these examinations is presented below.

Five cases were studied. In Cases 1, 2 and 3 (see Figs. AIV-10, 11 and 12), the plans are to cut much of the high northern ridge and fill the swamps, thereby preparing the required site area; a great volume of earthmoving is needed in these cases.

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In Cases 4 and 5 (see Figs. AIV-13 and 14), in order to minimize earthmoving, the plans are designed to prepare the minimum required area by leaving the north-south ridge, cutting land along on both sides of it, and filling the low land on the south; these cases require much less earthmoving than the preceding cases. The quantities for each of these cases are indicated as Table AIV-5. From these, Case 5, in which the whole area of the site is to be made at the elevation of 30 m, was identified as the best and used for further study of the site.

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#### 4-4 Site Preparation Planning

#### 4-4-1 Protection of the environment

In order to build the Complex which is in harmony with its natural environment, it is planned that the primeval forest within the northern boundary of the site, and outside the eastern boundary, will be left in its present state, so that they may function as a greenbelt.

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Such plans would also be effective to protect the Complex from any damage which may occur due to rapid surface run-off of rain, because retained vegetation would serve to keep water-retaining capacity of the soil high as well as to prolong the duration of time surface rain-water reaches the Complex site.

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## 4-4-2 Earthwork planning

The range of earthwork is to comprise the 0.2 to 0.3 m stratum of topsoil, the 3 to 4 m stratum of sandy silt below it, and the Neogene sedimentary stratum below that.

The quantity of cut will be about 1.07 million m<sup>3</sup>, and that of fill about 1.00 million m<sup>3</sup>, all to be moved by mechanical force.

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The upper, weathered soft portion of the sedimentary stratum can be broken up and moved by use of a bulldozer or ripper, but blasting will be necessary for a part of the sedimentary deposits.

Good quality sandy silt as well as weathered soft rock from the sedimentary deposits are to be used as fill. Topsoil and sandy silt which are not suitable for use as fill are to be removed from the site for disposal at a suitable place.

#### 4-4-3 Road planning

Specifications of the roads are designed in conformity to the Sarawak Public Works Department's Road Standard.

Paving thickness is to be 14 cm to 48 cm depending on the grade of road; all road surfaces are to be paved with bitumen or concrete.

The longitudinal slope of the access road from the Tg. Kidurong road is to be no more than 5% in order that the access road may be used for carrying plant equipment into the site.

#### 4-4-4 Damage accident, preparation planning

Most of the damages and accidents which happen during site preparation work are caused by water and soil.

In view of the characteristics of the site preparation work for this Complex which include the cutting of strongly undulating land and filling low land, it is necessary to plan for preventive measures which may protect the site preparation work from any damage or accident caused by rain-water run-off or the collapse of soil embankments. Further, regarding the protection of slopes and installation of adequate drainage and sewer facilities, careful attention must be given in surveys, designs and supervision of work. The major points to which consideration was given are as stated below.

## (1) Planning of the slope protection

In principal the inclinations of cut faces is to be 1.5: 1, and that of fill embankments to be 1.8: 1; the slopes are provided with berms of 2 m in width every 5 m

in height, and the surfaces of slopes are to be vegetated so as to prevent the earth from collapsing. Also, to prevent collapse at the toe of the slope, the toe part is to be provided with 2 to 3 m of stonework and a drainage channel is to be formed at the edge.

#### (2) Drainage of rain-water

By means of open drainage ditches, run-off rain-water on the site will be collected and discharged by gravity into the nearby river.

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The volume of run-off rainfall is to be estimated on the basis of study of rainfall data.

### 4-5 Problems and Points Requiring Attention

#### (1) Soil data

At the present time, because of the lack of soil data, the present planning was made on the basis of data from nearby areas. However, prior to proceeding with detailed planning of site preparation work, it is necessary to make investigation based on soil boring tests and plan the detailed site preparation work for execution, on the basis of soil data thus obtained.

## (2) Needs for a map showing topography of the area in detail

It is necessary to prepare a more detailed topographical map of the site than is now available, such as a 1/600 plan, which is needed for calculation of work volume, design and formulation of execution plan for site preparation.

#### (3) Damage and accident prevention

It is essential to plan for measures for prevention from damage and accident during site preparation work, including plans for proper drainage of rain-water during construction, prevention of the collapse of earth embankments and for maintenance of slope.

#### (4) Settlement of fill

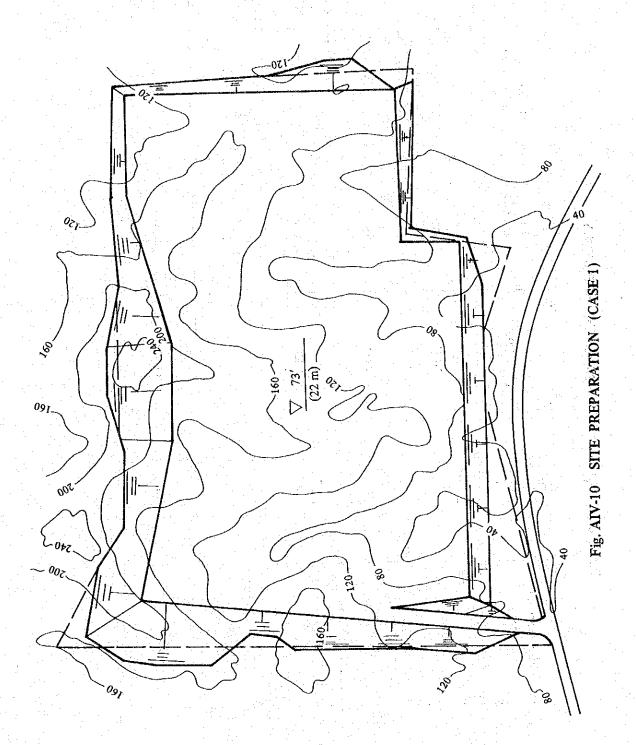
Even if fill is compacted, settlement cannot be prevented. Further, differential settlement is to be anticipated. These eventualities are to be taken into consideration during design work.

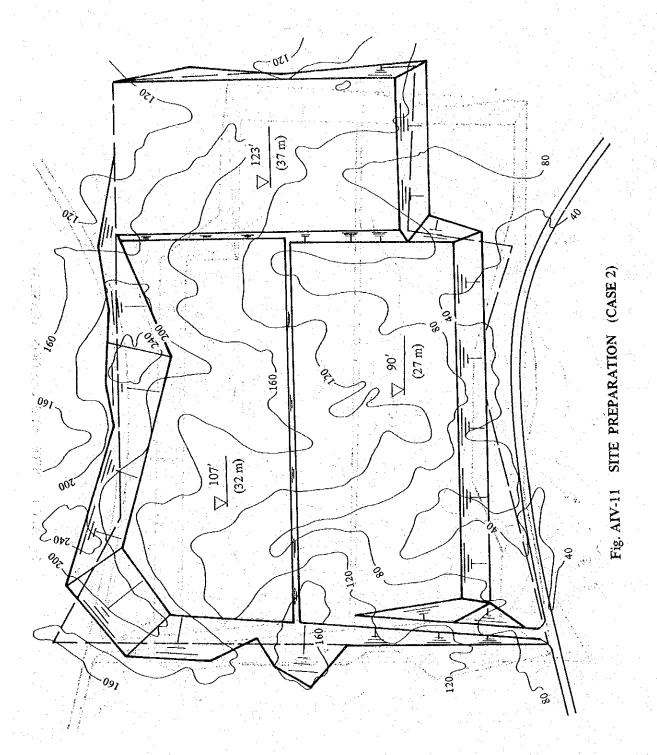
## (5) Soil disposal

Because it will be necessary to dispose, off the site, topsoil and silty clay which is not suitable for fill, it will be necessary to secure a suitable site for such disposal, and road access to it.

Table AIV-5 QUANTITIES FOR EACH CASE STUDY

Off-site Disposal m³ x 1,000	5,040	2,689	2,032	841	69
Fill m³ x 1,000	265	756	768	586	994
Cut m³ x 1,000	5,305	3,445	2,800	1,427	1,063
Area Worked ha	25	27	25	1.8	18
Final Elevation m (MSL)	22	27,32,37	27,32	27,30	30, 33
Case		7	m	4	\$





AIV-33

