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REPORT ON MISSION TO THAILAND

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11 March to 16 March 1971

by

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REPORT

on mission to Thailand, between 11 and 16 March 1971 by M.C. Verghese, Chief, Fertilizers, Pesticides and Petrochemicals Industries Section, UNIDO, Vienna and Nils Ramm-Ericson, Industrial Development Field Adviser (UNIDO), Bangkok.

I. INTRODUCTION

1. This report covers the visit of M.C. Verghese, Chief, Fertilizers, Pesticides and Petrochemicals Industries Section, UNIDO, to Thailand between 11 and 16 March 1971 and his mission undertaken jointly with Nils Ramm-Ericson, UNIDO Industrial Development Field Adviser, Bangkok.

2. The mission was initiated by the Applied Scientific Research Corporation of Thailand (ASRCT), taking advantage of Mr. Verghese's presence in the area. */

3. The major task for the mission was to discuss with the ASRCT/TRI officers and the management of the Chemical Fertiliser Co. Ltd. (Mr. Ramm-Ericson's letter, with attachments, to Mr. Siddiqui of 19 February 1971 refers to).

4. Discussions related to the work of the Fertilizers, Pesticides and Petrochemicals Industries Section at UNIDO Headquarters were also held with officers of the Ministry of Industry as well as at ECAFE and with the Association of South-East Asian Nations (ASEAN) Study Group.

5. A list of the persons met with and the industries and institutions visited is appended as Annex 4.

6. Latest information regarding the UNIDO Special International Conference, scheduled to take place in Vienna in June, was given to Dr. Vichitvong N. Pombhejara, Director of Industrial Economics and Planning Division, Ministry of Industry. Dr. Vichitvong confirmed that the intention was that either the Minister or the Deputy Minister of Industry would lead the Thai Delegation at the Conference. The Under-Secretary for Industry, Professor Yos Bunnag and Dr. Vichitvong would be members of the Thai Delegation both at the Industrial Development Board (IDB) and the Conference. **/ A copy of the latest UNIDO Aide-Mémoire (No.6) and Press Releases IDO/281 and IDO/288 concerning the Conference were handed over to Dr. Vichitvong.

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*/ Mr. Verghese undertook an SIS mission to Burma from 2-11 March 1971.

**/ Ref. Mr. Ramm-Ericson's letter to Mr. Luriá of 11 March 1971.

7. The mission wishes to place on record its appreciation of the help and kind services received from the Resident Representative and all others whom they met and for their willing co-operation.

II. Applied Scientific Research Corporation of Thailand (ASRCT) and the Technical Research Institute (TRI)

8. The ASRCT came into being by Act B.E. 2506 in May 1963 and became functional in July 1964 with the Prime Minister of Thailand as the Chairman and a Board of Governors and the Director General to guide its activities. The TRI which is financed by UNDP and for which UNIDO is the Executing Agency, came into being after the plan of operation of the project was signed on 19 November 1964. The TRI is a part of the ASRCT just like similar research institutes for agriculture, development studies and environmental research (Annexes 7 and 8 - Organisation charts of ASRCT and TRI).

9. The TRI was contacted by the Chemical Fertiliser Co. Ltd. of Thailand to assist the company in improving its production levels and solving various other problems connected with its operation. As TRI was set up inter alia to solve technological problems encountered by industry, such assistance would form part of its terms of reference. Therefore, the Research Director General of ASRCT, Dr. Pradisth Cheosakul, Dr. Kasem Balajiva, Managing Director (TRI), Dr. C.L. Wronshall, UNIDO Adviser/Project Manager (TRI) and Dr. C. Chu, UNIDO Adviser at TRI welcomed the opportunity to provide the assistance requested.

10. Dr. C. Chu made a visit to the chemical fertiliser company production plants at Mae Moh, Lampang in the Norther Province from 3-4 February 1971 and made a report dated 12 February 1971 (annex 3, Contact Note No.14/36).

11. This note was transmitted to UNIDO by Mr. Ramm-Ericson attached to his letter of 19 February 1971. He also requested that after the SIS mission to Burma by Mr. M.C. Verghese, UNIDO senior staff member, between 2-11 March 1971, he visits Bangkok (11-17 March 1971) to have discussions with TRI and other institutions and on the requirements of specialist assistance to the Chemical Fertiliser Co. and for long-term planning for the further expansion of the fertiliser industry in Thailand and other matters. It was also felt that the experience of the staff member in planning and executing a large fertiliser project in India based on lignite could be most helpful.

12. Based on the above request the mission to Bangkok was undertaken and a preliminary meeting was held in TRI in the afternoon of Friday, 12 March 1971 to plan further action. After a review of the situation in the Chemical Fertilizer Co. by Dr. Kasem and Dr. Chu, it was decided that Messrs. Verghese, Ramm-Ericson and Dr. Chu visit the plant at Mae Moh on 14 and 15 March 1971. It was also decided to hold a final meeting on Tuesday, 16 March 1971 at TRI and to invite the Managing Director of Chemical Fertiliser Co., Mr. Kraisri Chartikavanij so as to convey the findings of the team's visit to the plant. TRI handed over a large number of background documents on the Chemical Fertiliser Co. in particular and the fertiliser situation in general in Thailand. These documents as well as those obtained from other sources and at the Mae Moh plant are listed under "List of References".

III. Visit to the Chemical Fertiliser Co. Ltd.

13. In 1954, a semi-autonomous body called the Lignite Thermal Power Organisation (LTPO) was formed by the Government of Thailand to utilise the lignite deposits at Mae Moh, near Lampang, in the Northern Province. The first stage was the construction of a 12.5 M.W. steam generation plant which was completed in 1959 and electric power was supplied to Chiang Mai and to Yanhee for construction of the Bumiphol Dam. The name of LTPO was changed later to the Lignite Authority (L.A.) and its charter altered to permit a wider field of operation including fertiliser production.

14. The hydro-electric facilities at Yanhee went into service in 1964 eliminating the need for power from Mae Moh and hence the steam generation facility became superfluous. Consequently, construction of a fertiliser complex based on the strip-mined lignite was proposed and accepted by the Government.

15. The fertiliser complex was to use the lignite as mined containing 30% moisture, 12-15% ash, 25% volatile matter, 2.5% sulphur and 25% fixed carbon. The temperature at which the lignite ash melts is around 1300°C. Required steam in addition to steam generated in the complex was to be supplied by the Mae Moh steam generation plant and electric power from the same source as well as the Bumiphol Dam.

16. The overall contract for design engineering, supply of equipment, construction and trial runs for the complex were given to a consortium of W. German firms with Uhde serving as the prime contractor and B. Grimm and Co., a trading and engineering firm in Bangkok, acting as local agents. The Chemical Fertilizer Co. is Government-owned to the extent of 68% (Ministry of Finance) and the rest is owned by private sector, namely individuals, banks, etc. There is a large loan from the Kreditanstalt Wiederaufbau, FRG which is being repaid by the company. The total investment for the project is estimated to be 350 million Bahts.

The plant was to produce the following products (26,000 tons nitrogen in products per year based on 330 working days):

Ammonia	33,000 tons/year	(= 27,000 tons N)
Urea	28,000	
Sulphuric acid	48,000	
Ammonium sulphate	63,700	(All in round figures)

The processes employed, the capacities of the units, raw material requirements and the firms involved are given in Table 1 (refer flow sheet Annex 14).

Table 1

Names of firms, processes and products

Name of firm	Process	Raw materials per day tons	Raw materials per year tons	Products per day tons	Products per year tons
1. Koppers	Lignite drying oxygen gasification, gas cleaning	lignite 270		Raw gas	
2. Linde	Air separation	air		O_2 N_2	
3. Shell	ADIP solution			Sulphur 4.5	
4. Halberg	Synthesis gas compression (vertical-reciprocating) max.450 kg/cm^2				
6. Uhde	Co-conversion 24 kg/cm2 single shift conversion				
7. Uhde	CO_2 - removal water scrubbing 21 kg/cm2 Final purification copper liquor wash 110 kg/cm2				
8. Uhde	Ammonia synthesis medium pressure 450 kg/cm2 max.			100	33,000
9. Stami-Carbon	Once through or partial recycle urea process			85	28,000
10. Lurgi	Sulphuric acid	Sulphur 49		146	48,000
11. Lurgi	Ammonium sulphate	50 - NH_3 146 - H_2SO_4		193	63,700

17. The plant was completed and started production in 1967 under the name of Chemical Fertilizer Co. Ltd. (CHEMFERCO). The estimated total cost of the project is about 17.5 million US dollars. During the first year (1967) of operations, the plant faced power shortages resulting in low production. By June 1968, however, the unsold stocks reached over 35,000 tons partly due to unrestricted imports of lower-priced fertilizers. The Government therefore banned imports of ammonium sulphate and urea and the plant sold the products and reduced the stocks. However, production and sales did not reach full capacity and targets. Although the factory again attempted to increase production in 1970, none of the units could achieve designed capacity for long periods as seen from figures given in the Table 2 below (which is an analysis of production figures for 1970, Annex 17):-

Table 2

Analysis of effective use of plants

1970 Month	Production (effective use) as % of designed capacity			
	Ammonia (NH_3)	Sulphuric Acid (H_2SO_4)	Ammonium (NH_4) SO_4 sulphate	Urea $CO(NH_2)_2$
January	61.50	67.83	60.89	63.79
February	45.00	47.00	46.00	47.00
March	28.00	28.00	26.00	27.00
April	36.00	36.00	29.00	38.00
May	37.00	38.00	32.00	37.00
June	60.00	63.00	55.00	56.00
July	37.00	55.00	34.00	35.00
August	41.00	59.00	36.00	41.00
September	47.00	67.00	44.00	52.00
October	42.00	58.00	44.00	40.00
November	38.00	46.00	35.00	40.00
December	21.00	41.00	25.00	16.00
	493.50	605.83	466.89	492.79
Average for 12 months	41.13	50.49	38.86	41.07

18. An analysis of the figures in the above table show that for a 12-month period of continuous operation in 1970 the percentage of production compared to design capacity were as follows: -

	Ammonia	Sulphuric Acid	Ammonium sulphate	Urea
Average for 12-month period	41%	50%	39%	41%
Number of months operated above 90% designed capacity	2	6	2	3
Number of months operated above 80% designed capacity	1	2	1	1

19. In Table 3 are given figures to show whether the units if ever operated at design capacity and if so maximum capacity attained and what % of designed capacity was attained. The table also gives the number of days when there was no production and % of down-time based on 330 working days.

TABLE 3 - Analysis of maximum capacity attained and down-time

1970 Months	Maximum capacity attained in any one day during the months T/D				Number of days when there was no production				Percent days of no production based on 330 days			
	Ammonia	Sulphuric acid	Ammonium sulphate	Urea	NH_3	H_2SO_4	A.S.	Urea	NH_3	H_2SO_4	A.S.	Urea
Designed capacity	100	146	193	85								
January	93.78	139.44	194.50	88.95	1	1	4	4				
February	62.21	120.80	164.00	71.70	8	5	10	11				
March	60.78	101.20	196.80	84.85	14	16	19	19				
April	63.14	101.60	141.50	75.68	9	9	11	12				
May	63.50	139.44	159.50	86.28	5	9	12	12				
June	61.35	121.02	156.20	73.95	3	2	3	8				
July	61.45	137.44	182.00	86.35	7	2	10	14				
August	61.85	134.03	145.70	76.25	6	3	10	9				
September	61.13	125.06	142.50	72.58	3	3	1	7				
October	65.14	125.36	194.00	80.88	4	2	6	10				
November	60.74	113.41	188.60	84.60	8	4	13	13				
December	82.64	140.24	177.50	72.28	17	8	16	20				
12 /	797.71	1499.04	2042.80	954.35	85	62	121	139	26	19	37	42
	66.5	125.00	170.20	79.50								

Notes:

(a) Out of 365 days

Ammonia plant never attained designed capacity

Sulphuric acid plant never attained designed capacity

A.S. plant attained designedcapacity during 3 days

Urea plant attained designed capacity during 5 days

(b) Out of 330 on-stream days

Ammonia plant did not produce 26% of days

Sulphuric acid plant did not produce 19% of days

A.S. plant did not produce 37% of days

Urea plant did not produce 42% of days

(c) Based on the maximum production attained during one day in each month, the following possible average production can be attained (theoretically):

	(1) Possible maximum production T/D Based on maximum production of one day each month (average)	(2) Based on highest production of any day	(3) Based on (1) % of designed capacity	(4) Based on (2) % of designed capacity
Ammonia	66.5	93.78	66.5	94
Sulphuric acid	125.0	139.44	85.6	96
A.S.	170.2	194.50	88.2	100
Urea	79.5	88.95	93.6	100.5

20. An analysis of the reasons for the shut-down of the units during 1970 reveals the following (refer damages or troubles of fertiliser plant, Annexure 17): -

Gasification

- Blocking by slag of gasifier
- Overload of lignite feed screw units and automatic shut-down
- Damage to ash extractors
- Leaks in gasifier bottom part
- Defect in time relay of lignite service bin
- Back fires in gasifier
- Short supply of lignite
- Blocking of boiler tubes and boosters

Ammonia synthesis

- Breaking of second stage pistons of both syn gas compressors
- Defect in copper solution pump
- Short circuit in 2500 K.W. motor of synthesis gas compressor
- Leak in inter-coolers of compressor
- Breaking of valve plates of synthesis gas compressor
- An automatic trip-off of compressor motor due to starting overload
- Leak in stuffing boxes of circulating compressors

Air separation

- Defect in four-way valve of regenerator
- Wearing of carbon brush of exciter of 2.2 M.W. motor of air-turbo compressor
- Leak in first and second stage intercooler of air-turbo compressor
- Defect in regulating valve of regenerator
- Defect in blow-off valve

CO_2 removal

- Damage to Escher-Wyes Turbine
- Damage to Thrust bearings of Turbine
- Defect in Turbine regulation mechanism
- Automatic shut-down of Turbine

Urea synthesis

- Insufficient ammonia
- Repair to urea reactor
- Defect in ammonia high pressure pump
- Defect in flow meter of liquid ammonia
- Automatic shut-down of CO_2 compressor
- Defect in CO_2 drying unit
- Leak in safety valve of NH_3 high pressure pump
- Blow-out of high pressure line from urea reactor
- Leak in gas cooler pipe of CO_2 compressor

Sulphuric acid

- Storage capacity full
- Defect in valve of sulphur pump
- Damage to sulphuric acid pipe to drying tank
- Defect in molten sulphur pump

Ammonium sulphate

- Insufficient ammonia supply

Power station, sub-station, Yanhee power line

- Temporary earth fault
- Reverse power relay in power plant
- Short circuit in switch gear
- Yanhee power line fault
- Break-down of secondary of super heater in power plant and hence no steam
- Exciter trip due to testing exciter of synthesis gas compressor
- Lightning on 11 KV line from power station
- D.C. earth fault

21. During the visit of the mission to the Chemical Fertiliser Co. Ltd. on 14 and 15 March 1971 at Mae Moh, Lampang a detailed discussion with most of the key personnel (for list of key personnel see Appendix 11) took place. Mr. Somnuk Prdithsvony, Acting Works Manager, took the party to visit all the plants, the power station of the Lignite Authority, water storage and treatment area, chemical laboratory and workshop. Some parts of the damaged second stage pistcn and rod of the synthesis gas compressor and the burst high pressure pipeline-exit of the urea reactor were also examined.

22. The inspections of the plants and discussions further confirmed the following: -

(a) Operations, maintenance and safety manuals are not readily available. Instruction booklets on machines and instruments, detailed drawings and blue-prints are missing. It is essential that top management get in touch with either the prime contractor Uhde or the suppliers of individual equipment and get enough copies of drawings and manuals.

(b) Essential and critical spareparts for machines and instruments are not available. As examples, it may be pointed out that special bricks for lining the lignite gasifier, thermo couple elements for measuring temperature, piston rings for synthesis gas compressors and CO_2 compressors, gland housing and stuffing boxes for synthesis gas circulating compressors, are not in stock.
Orders must be placed for such critical items immediately and a minimum spareparts position established in the stores.

(c) Maintenance work, especially-planned preventive maintenance must be instituted. Instead of waiting for a break-down, inspection and maintenance on critical items must be carried out periodically. The workshop must be better fitted and the instruments repairs must be tightened.

(d) The continuous supply of cooling water, de-mineralised water for boilers, steam and power should be ensured.

(e) Studies on corrosion, water treatment, etc. should be started. An instrument to measure thickness of high pressure pipelines while under operation must be immediately bought and used.

(f) Efforts should be made and steps taken to retain trained key personnel in the Mae Moh area. Higher scales of pay, bonuses, training abroad, facilities for schooling of children, recreation facilities, etc. are some of the steps necessary. In-plant training programmes for operators, maintenance men, etc. must be instituted immediately.

(g) The oxygen gasification plant and especially the Koppers gasifier seems to be the biggest bottleneck in attaining continuous maximum production. Better control of temperatures, inspection of brick lining and control of the the gasification process as such are essential. The gasifier operation as it exists constitutes a potential dangerous aspect of the whole production system.

23. In this connexion the detailed inspection notes prepared by Dipl.Ing. W. Fliess of B. Grimm and Co. (Annex 21) and the Contact Note No.14/49 (Annex 22) prepared by Dr. C. Chu of TRI who was a member of the mission who visited the plant, are very illuminating and worth serious attention of the authorities.

24. The mission on return to Bangkok met with Mr. Kraisi Chartikavanji, Managing Director of the Chemical Fertiliser Co. and senior officials of ASRCT and TRI. The findings of the mission were verbally reported and short-term and long-term plans for bringing up the production of the Mae Moh plant discussed.

25. The writer of this report and Dr. Chu of TRI later met with Mr. Fliess, Manager of Engineering Department of B. Grimm and Co. of Bangkok. Grimm and Co. as stated earlier were the main agents for all imported equipments of the Mae Moh plant. Mr. Fliess also recently made a survey and report of the difficulties in the operation of the plant.

26. It is the feeling of the mission that the Chemical Fertiliser Co. should make use of the experience and services of the Grimm and Co. in obtaining operation and maintenance manuals, blue-prints and detailed booklets on all equipments. All orders of spareparts can be channelled through this company if a mutual understanding is reached. This procedure may be quicker and cheaper in the long run. Anyway, such co-operation should be investigated.

IV. Department of Science

27. Discussions were held with Dr. Charoon Vasharangsi, Chief Division of Physics and Engineering, Ministry of Industry (Annexure 27) in which Miss Gonsombat (who took part in UNIDO plastics training course from 14-27 September 1970) and Mr. Wallden, Project Manager, UNIDO SF project TISI (Thai Industrial Standards Institute) took part. The following subjects were discussed and the conclusions and recommendations are given below: -

(a) As per letter No.362 from Mr. Ramm-Ericson to Mr. Siddiqui dated 18 March 1971 (Annex 28) it was conveyed to Dr. Charoen that, with reference to the advance copy of the job description for a six months SIS expert - mechanical engineer or chemical engineer (plastics equipment and machinery expert) and a list of equipment for plastic study and testing (Annexes 29 a and b), the assistance in this field be initially provided by the UNIDO/ECAFE Regional Adviser on Petrochemicals when he comes on board. Mr. H. May, staff member, may also visit Bangkok in this connection after his proposed mission to Rangoon.

(b) Regarding the request for an economist (plastics market) for which a draft job description was sent with Mr. Siddiqui's letter of 10 November 1970 (Annex 30) the Board of Investment is interested in the services of an expert under SIS to assesss and make recommendations concerning the development of Thailand's plastics industry along the lines of the draft job description attached to Mr. Ramm-Ericson's letter of 1 March 1971 to Dr. Amnuay Viravan (Board of Investment) copied to UNIDO. Mr. Ramm-Ericson may kindly be requested to put an official request.

*/ Mr. Verghese undertook an SIS mission to Burma from 2-11 March 1971.

**/ Ref. Mr. Ramm-Ericson's letter to Mr. Luriá of 11 March 1971.

V. Association of South-East Asian Nations (ASEAN)

28. Discussions were held with Dr. G. Kansu, team leader of the ASEAN Study Group in which Mr. Karaoglan of the Study Group and Mr. S. Skoumal, systems and marketing consultant, UNIDO, Bangkok, participated. Dr. Kansu pointed out that the fertiliser industry has been identified as one of the major industries to be studied by the team for the member countries - Indonesia, Malaysia, Philippines, Singapore and Thailand. Dr. Kansu also stated that based on their preliminary study, further studies in depth are necessary. For this the services of a fertiliser industry specialist from UNIDO under the SIS programme for six months was indicated.

29. A project description (data sheet) was prepared and sent to Dr. Kansu along with a letter from Mr. Ramm-Ericson dated 12 March 1971 (letter No.175) (Annex 30 a and b). In that letter Dr. Kansu has been requested to approach the ASEAN contact officers in the five countries. If positive response is obtained, then the Government endorsement of the project should be submitted through the formal channels (the technical assistance co-ordinating bodies of the respective governments) to the UNDP Resident Representative of each country for forwarding the request to UNDP and UNIDO Headquarters. UNIDO should await such request.

VI. Economic Commission for Asia and Far East (ECAFE)

30. A meeting was arranged in the ECAFE, Division of Industry and Natural Resources, by Dr. C.Y. Li, Deputy Director, in which Mr. Tin Nyunt among others took part. In addition to detailed discussions of the industrial promotion meeting in Singapore in which Mr. Burgers from UNIDO took part, the following subjects of interest to the mission were discussed: -

(a) ECAFE has recommended to UNIDO the name of Mr. J.T. Shen as the ECAFE/UNIDO Regional Adviser on Petrochemicals. He was a UNIDO expert in Singapore in 1967 and 1968 as Senior Industrial Research Adviser to EDB and is presently chairman of the Petrochemical Industries Corporation in Taiwan. ECAFE had informal contacts with him and positive indications of his interest and availability have been obtained. UNIDO has to give clearance for his appointment.

(b) The Asean Pesticides Survey

UNDP has suggested that this may overlap with the FAO's global project GLOB-9. This has been clarified and a letter to agree to the principle has been sent to UNDP attaching the amended project data sheet and job description by FAO (Annex 33). Official request from two more countries is still awaited.

(c) Petrochemicals Survey in Indonesia including Caprolactam

It is understood that the survey has been cleared by the concerned ministries and is now with the Committee of Co-ordination in Djakarta. ECAFE's and Mr. Ramm-Ericson's assistance was requested to get it through to UNIDO for early execution.

(d) Second Interregional Fertiliser Symposium

It was explained to the meeting that UNIDO is organising the Second Interregional Fertiliser Symposium in Kiev, USSR from 21 September to 1 October 1971 and in New Delhi, India from 2-10 October 1971. The participation of ECAFE was requested similar to the participation in the first symposium in Kiev in 1965. ECAFE was rather reluctant to present a summary paper on the situation of the fertiliser industry in the ECAFE region in view of the many recent studies prepared, especially the one by Dr. G. Kemmler on "Fertiliser requirements study for seven countries in South and East Asia" ECAFE/FRC project of March 1970. In this connection it was mentioned that UNIDO is presently compiling a fertiliser production survey for Asia. ECAFE is interested in this compilation.

(e) Mention was also made by the officers of ECAFE of the French Report on South-East Asia petrochemicals complex referred to in para.16 of Mr. Ramm-Ericson's report BKK/58(71) on the 6th Session of AIDC in January 1971.

(f) After the ECAFE/UNIDO Regional Adviser on Petrochemicals takes up his position and after he surveys the plastics fabrication and the plastics market in Thailand for the Department of Science, he should prepare an information paper on the establishment of a plastics technology centre in Bangkok. UNIDO will provide him with some information on similar centres envisaged for other countries as a model.

VII. Conclusions and Recommendations

Chemical Fertiliser Co. Ltd.

(Those relating to ASRCT and TRI are given before under the respective headings)

31. The situation in Thailand regarding Chemical Fertiliser Co. at Mae Moh and in planning to meet the existing and future requirements of fertilisers in Thailand should be approached from a short-term point of view as well as from the long-term viewpoint.

A. Short-term approach

32. The mission has come to the conclusion that the production of the fertiliser factory at Mae Moh can be increased and kept at a higher level if the following steps are taken. Action has to be taken by the Executive Board of Directors (or the Prime Minister's Committee) and assistance to solve problems requested from ASRCT, TRI and UNIDO.

(a) Place orders through Grimm and Co. Bangkok or directly with the suppliers for critical items of spares, raw materials and other supplies needed for one year of operation. The management and technical personnel at Mae Moh exactly knows what is needed and they should be requested to draw up such a list with approximate cost estimates (Board of Management to take action).

(b) ASRCT and TRI to be requested by the Board of Management of CHEMFERCO to constitute a task force to study and solve problems connected with cooling water supply and storage, boiler feed water supply, steam supply and an analysis of problems connected with electricity supply. Increasing intermediate storage of products be also looked into. Studies on corrosion and materials of construction to be undertaken. (Action Dr. C. Chu of TRI - A detailed plan of how to attack the problems to be formulated first.)

(c) UNIDO to be requested to supply the following assistance: -

i) Services of a lignite-oxygen gasification expert for 6-12 months to rationalise the safe operation of the gasification plant. Job description attached (Annex 23). He will serve as the team leader of UNIDO experts.

ii) Services of a mechanical engineer with long experience in equipment repairs, maintenance and fabrication of spareparts required for the different plants and processes at Mae Moh for 6-12 months. Job description is attached (Annex 24).

iii) Services of an electrical cum instruments engineer for a period of 6-12 months. Job description is attached (Annex 25).

iv) Fellowships to be requested from UNIDO for a six months period for the following personnel for undergoing training in a similar plant for example in India: -

Sub-Manager - Lignite gasification plant
" Maintenance - mechanical
" Instrumentation
" Electrical maintenance

(24 man-months of fellowships to be negotiated to be awarded in India at the Neyveli Lignite Corporation - Neyveli, Madras, India. Mr. J. Lascelles, Senior Industrial Development Field Advisor in India has already indicated that India is willing to train fellows in Neyveli from other developing countries.)

B. Long-term planning

33. Thailand is now importing about $ 25 million worth of fertilizers per year in addition to the use of products from Mae Moh and the consumption is increasing at the rate of about 10% per year. The Mae Moh unit should be brought up to full production but no more expansion of nitrogen production using lignite should be done immediately. Lignite-based plants are capital intensive, the processes are difficult to operate and costs of production will be high. Lignite should be used as fuel for electricity production to stabilise hydro-electric production.

34. There is scope to use refinery off-gases or naphtha from the refineries near Bangkok to put up a 600 or 1000 tons of ammonia per day plant in a single stream. To start with phosphoric acid can be imported as well as potash and N-P-K mixtures as needed by Thai agriculture can be produced at low cost. Such large low-cost production pooled with the small high-cost production from Mae Moh can off-set the difficulties of the Mae Moh unit.

35. It is therefore recommended that the Thai Government should constitute a fertiliser planning cell to study all relevant problems connected with the industry such as present demand, future demand up to 1980, production capacity needed, location, raw materials, types of products, imports, marketing and distribution of products, price supports needed, legislation required, etc.

36. UNIDO should be requested to provide the services of asen.fertiliser industry planning adviser for a period of one year. Job description is attached (Annex 26). He will organise and conduct the activities of the planning cell with the help of four to five experts from Thailand as required. The planning cell must be attached to the Prime Minister's Office.

37. Ultimately, all matters concerning fertilisers in Thailand should be vested with one organisation such as a Fertiliser Authority of Thailand (FAT) under which all planning, production units, marketing, research and development and other functions will be centered. This appears to be the best long-term plan for the industry in Thailand and FAT may have the following functions: -

- Planning future developments
- Production
- Construction and maintenance
- Marketing and distribution
- Credit
- Legislation
- Imports, etc.
- Training
- Research and development
- Information

Annex 1

UNITED NATIONS DEVELOPMENT PROGRAMME

PROGRAMME DES NATIONS UNIES POUR LE DEVELOPPEMENT

Telephone 57001-3

OFFICE OF THE REGIONAL REPRESENTATIVE
548 Ploenchit Road
P.O.Box 618
Bangkok, Thailand

Cable Address: "UNIDEVPRO" BANGKOK

Ref. THA/1-21
Letter No. 141

BY AIRMAIL

URGENT

12 February 1971

Dear Siddiqui,

Sub.: TRI/THAILAND: Fertiliser Industry

In view of Mr. Verghese's visit to Rangoon early next month, I would like to bring you up to date regarding the activities of TRI here in Bangkok in the fertiliser industry field. Perhaps, a visit to Bangkok for a couple of days by Mr. Verghese in connexion with the Rangoon mission might be possible. The TRI would very much welcome such visit. I, therefore, attach a copy of a note dated 12 February 1971 prepared by Dr. Chu of TRI indicating requirements of specialist assistance in fertiliser production for long range planning as well as specific feasibility study on the modifications of processes and development of new fertilisers.

Best personal regards,

Yours sincerely,

Nils Ramm-Ericson
Industrial Development Field Adviser
(UNIDO)

Attachments: Dr. Chu's memorandum of 12 February 1971
Contact Note No. 14/16 - Fertiliser Industry
No. 1. Ammonium Sulfate from Calcium Sulfate
No. 2. Flow sheet of ammonium sulphate plant
No. 3. Phosphoric acid by wet process.

Mr. M.A. Siddiqui
Chief of Section for Asia
Technical Co-operation Division
UNIDO, Vienna
AUSTRIA

cc: Mr. Wali, UNDP, Bangkok (+ att.)
Dr. Wrenshall, TRI, Bangkok
Mr. Verghese, UNIDO, Vienna
PSSU, UNIDO, Vienna

Annex 2

23088 inco ch

79618a unido a

ub-89 (unido) vienna 37 25 1407z -

tof

undevpro

bangkok (thailand) -

niso 3883 rsmn orienon roselet 2 february agree tuesday

stopover bangkok verghese after rangoon mission. probable dates

15/16 march. kindly arrange meetings with tri and visit thailand

fertiliser factory -

cc: Mr. Verghese
Registry
Mr. Siddiqui
Mr. Gnanasambalioo

siddiqui unido vienna +

cnl 3883 19 15/16 +

Annex 3

APPLIED SCIENTIFIC RESEARCH CORPORATION OF THAILAND

[redacted]

Subject: Fertiliser Industry

To: Dr. Prudisth, Dr. C.L. Wrenshall and Dr. Kasem

From: C. Chu Date: 12 February 1971

The attached contact note suggests some directions of development for the Chemical Fertiliser Co., which has requested our assistance regarding their plan of improvement.

Our expertise in this field is rather limited. I understand that the General Manager of Chemical Fertiliser Co. has contacted Mr. K.S. Chang, Deputy Minister of Economic Affairs of the Republic of China, when Mr. Chang was attending the ECAFE meeting in Bangkok.

Further development of this technical assistance to the Chemical Fertiliser Co. by TRI may call for the services of UNIDO experts in fertiliser production for long range plan and feasibility study on the modifications of processes and development of new fertilisers.

CONTACT NOTE NO. 14/36

Subject: Fertiliser Industry

Contact: Mr. Somnuk Pradithavanij, Acting Mill Manager
Chemical Fertiliser Plant, Mae Moh, Lampang

Contacted by: Dr. C. Chu
Dr. Bancha
Mr. P.C. Yue (formerly Sales Manager, Taiwan Fertiliser Co., Republic of China)

Date: Feb. 3-4, 1971

Place: Mae Moh, Lampang

Remarks:

The purpose of this visit was to study the problems of this fertiliser plant. Mr. Somnuk conducted a tour to the plant and explained the flow sheet of the plant from raw material to finished products. The problems discussed were mainly concerned with the gasification plant which uses lignite as raw material. The ash content of lignite amounts to 15 percent. The plant has to keep a good ratio of CaO to SiO_2 in the slag to effect proper formation of calcium silicate at the operating temperature about 1300°C. At present diatomite is added to the lignite and then dried to remove moisture in the lignite diatomite mixture. Operation of the plant encounters many maintenance and control problems. Our brief visit can only suggest some ideas for improvement as follow:

1. Reduction of ash in lignite may be effected by washing. But some experimental work is necessary to determine how effective is washing in reducing slag after combustion.
2. Some modifications of processes may reduce production cost and enhance expansion as for example the following items:
   a. Production of ammonium sulphate from gypsum.
      This process as shown in the attached flowsheet No. 1 can use local gypsum instead of imported sulfur. The plant is consuming about 50 t/d of sulfur at US 325/t FOB. This foreign exchange can be saved. The gypsum

process gives by-product calcium carbonate which may be used directly or converted to lime by calcining as shown in the second reaction:

$$2NH_3 + CO_2 + CaSO_4 + H_2O \longrightarrow (NH_4)_2SO_4 + \underline{CaCO_3}$$

$$CaCO_3 \longrightarrow CaO + CO_2 \quad \text{(if desired)}$$

b. Production of mono-ammonium phosphate fertiliser with phosphoric acid.

If gypsum is used to make ammonium sulphate, the existing ammonium sulphate plant featuring neutralisation of sulphuric acid with ammonia and crystallisation of ammonium sulphate can be modified to use imported 79% phosphoric acid for production of mono-ammonium phosphate, which is concentrated fertiliser with a good market in Thailand. The attached flow sheet No. 2 indicates the partial use of phosphoric acid in an ammonium sulphate plant.

c. Production of phosphoric acid with imported phosphate rock.

If gypsum is used to make ammonium sulphate, the sulphuric acid plant at 45 t/d can be diverted to make phosphoric acid by an improved wet process as shown in the flow sheet No. 3. The new process features the use of fuming sulphuric acid containing 5-20% free SO_3. The phosphoric acid plant with a capacity of 100 t/d may need about 220 t/d of phosphate rock (70 B.P.L.) or 70,000 tons per year. In this process gypsum or $CaSO_4$ is produced as a by-product.

d. Production of synthesis gas from imported naphtha instead of gasification of lignite.

With a developing fertiliser market in the North, use of imported naphtha or hydrocarbon for gas generation should be considered to improve the efficiency of plant operation. Naphtha costs about US $ 18 per ton CAP. Whether the existing gasifier in Mae Moh can be modified to use naphtha and whether the idle gasifier for coke from Taiwan Fertiliser Co. can be reconditioned for naphtha need expert appraisal. Consultation with Taiwan and UNIDO experts is suggested. However the idle gas purification units and ammonia urea plant in Taiwan of about 50 t/d ammonia in capacity may be taken into consideration for expansion of the Mae Moh

plant to 200 t/d ammonia with naphtha or other hydrocarbons as raw material.

In the meantime, the proposal of importing a new gasifier for lignite from Germany as a spare unit is not only expensive but also not practical as it takes two years to complete the new installation. Even with the new spare gasifier installed, any breakdowns in other sections of the plant will still effect the operation of the gasification plant.

c. Production of superphosphate with imported phosphate rock.

Superphosphate can also be produced with imported phosphate rock and local sulphuric acid available in the Mae Moh plant. Technology and equipment are available from Taiwan.

With production of two kinds of fertiliser, a mixed fertiliser plant (using imported potash) can be added to the Mae Moh plant to meet various needs of mixed fertiliser formulated for specific soil and crops.

3. Reduction of packaging cost with multi-wall paper bags.

The fertiliser plant uses gunny bags with polyethylene film lining for packing ammonium sulphate in 50kg packs. Imported polyethylene bags are used to pack urea in 25kg packages. The cost for the gunny bags is about 5 baht each, including sewing threads for the bag seaming. The heavy polyethylene bags cost 3.35 baht each CAF. In Taiwan all fertiliser bags are made of paper. Multi-wall paper bags with one layer lined with polyethylene or asphalt can be made by the Siam Kraft Paper Mill, which is now in difficulty due to high cost of imported pulp and heavy financial burden. We envisage that better production of pulp in Thailand can improve the operation of this mill to supply low cost paper bags for cement and fertiliser.

4. Production of pulp from pinewood with power and steam from lignite.

The use of naphtha instead of lignite for production of synthesis gas may release the lignite for other uses. The paper industry in Thailand may be encouraged to use lignite for steam and power by establishing a pulp mill in Lampang. Waste sulfide solution and spent alkali in Mae Moh plant can be used

for pulp production. Raw materials for pulp in the North are abundant. Pinewood can be delivered to Lampang by train or trucks. The sugar mill in Lampang can supply bagasse with lignite as substituted fuel.

5. Production of slow-release fertilizer by a coating process.

The monsoon rain in Thailand and floating rice crops are unique, requiring specific mixed fertilizer which can stand the leaching and retain its potency during the crop growing season. Dr. C.L. Wrenshall as a soil chemist has suggested that slow-release fertilizer may benefit the farmers. Reasons for the savings in fertiliser of this kind include greater yields of crops as a result of the steady nutrient supply, reduced leaching losses, lower labor costs due to fewer application, and lessened hazard to crops as a result.

Production of slow-release fertiliser would involve only an additional coating process applied to the mixed fertilizer or urea. The coating material amounts to about 10-15 percents on the weight or fertiliser. The acid soil in Thailand may be benifited by a lime coated fertilizer. Recent development indicates that sulfur coating with wax as a binding material is economical.

The binding material for coating fertilizer may come from wax which is a by-product of rice bran oil industry. However some experimental work will be required to determine its feasibility for this particular application in the production of slow-release fertiliser.

6. Market control and extension through agricultural extension services.

With the great expansion of fertiliser production as above suggested, a controlled marketing system under government monopoly of fertiliser production and distribution through farmers organisations and Provincial Food Bureau with a credit system may be required. The fertiliser price in Taiwan is under government control.

Effective use of fertiliser requires good agricultural extension services. In some cases such as cotton and tobacco crops, application of fertiliser must be co-ordinated with proper insecticides. Production of insecticides with imported intermediates and ingredients in bulk would involve very limited investment but may help to enhance the distribution of fertiliser.

International market price of urea fertilizer is about US $60 per ton and ammonium sulphate about US $30 per ton against 2,400 baht per ton of urea and 1,250 baht per ton of ammonium sulphate in Thailand. These high prices certainly reduce the incentive of farmers to use fertilizer for their crops unless the cost is justified by high cash return from their crops. Some high return crops such as tobacco, pineapple, oilseeds, cotton and vegetables can afford higher cost of fertilizer, whereas paddy rice, kenaf, corn and tapioca at present seldom receive any fertilizer, simply because their increased return from fertilizer application may be marginal. Lack of cheap fertilizer not only depletes the soil, but also encourages shifting agriculture on forest land. Therefore a major overall objective must be to reduce the cost of fertilizer in Thailand.

7. Preventive maintenance and quality control.

It is quite understandable that the Mae Moh has only operated for two years with many problems of maintenance. Good maintenance work stresses on preventive maintenance and keep a good record of maintenance jobs and proper stock pile of spare parts. Any unusual occurances of repairs besides normal wear and tear should be analyzed for its causes. Some could be wrong materials of construction, some from poor designs and some from defects in installation and lubrication.

Training for preventive maintenance and quality control in fertilizer plant is not available in Thailand. Such assistance could be arranged with the Taiwan Fertilizer Co., which has seven plants with annual production over one million tons.

Supply of spare parts of good quality by local manufacturers should be developed to save cost and time of delivery. Next comes to prospective good suppliers from neighbouring countries such as Republic of China and Japan. Imports from Europe or the United States take a long time even from their stock. Keep a list of suppliers for spare parts and extend own shop facility for making some parts within the economic means are matters concerning the plant management.

List of persons met with and industries and institutions visited by the mission

Applied Scientific Research Corporation of Thailand (ASRCT)

Dr. Pradisth Cheosakul, Research Director-General, ASRCT

Dr. Kasem Balajiva, Managing Director, Technological Research Institute (TRI)

Dr. C. Chu (UNIDO) Chemical Engineer, TRI

Dr. C.L. Wrenshall, Project Manager

Chemical Fertilizer Co. Ltd.

Mr. Kraisri Chartikavanij, Managing Director

At factory site, Mae Moh:

Mr. Somnuk Pradithavanij, Ag. Plant Manager

See Annexure II

B. Grimm and Co.

Mr. Flioss, Manager of Engineering Department

Department of Science, Ministry of Industry

Dr. Charoen Vashrangsi, Chief, Physics and Engineering Division

Miss Oonsombat

Mr. Lars Wallden (UNIDO), Project Manager, Thai Industrial Standard Institute (TISI)

Industrial Economics and Planning Division (IEPD), Ministry of Industry

Dr. Vichitvong N. Pombhejara, Director

ECAFE Division of Industry and Natural Resources

Dr. C.Y. Li, Deputy Director

Mr. K.A. Dikshit, Chief, General Section

Dr, K.R. Chou, Chief, Industrial Studies Section

Mr. Tun Thein, Chief, Small-scale Industries Section

Mr. Tin Myunt, Economic Affairs Officer, General Section

Mr. Achmad Slamet, Economic Affairs Officer, General Section

Dr. H.G.R. Reddy, UNIDO/ECAFE Regional Adviser (Agro. and Light Industries)

UN Research Project on ASEAN Economic Co-operation (ASEAN Study Group)

Dr. G. Kansu, (OTC), Team Leader

Mr. R. Karaoglan, (OTC), Economist

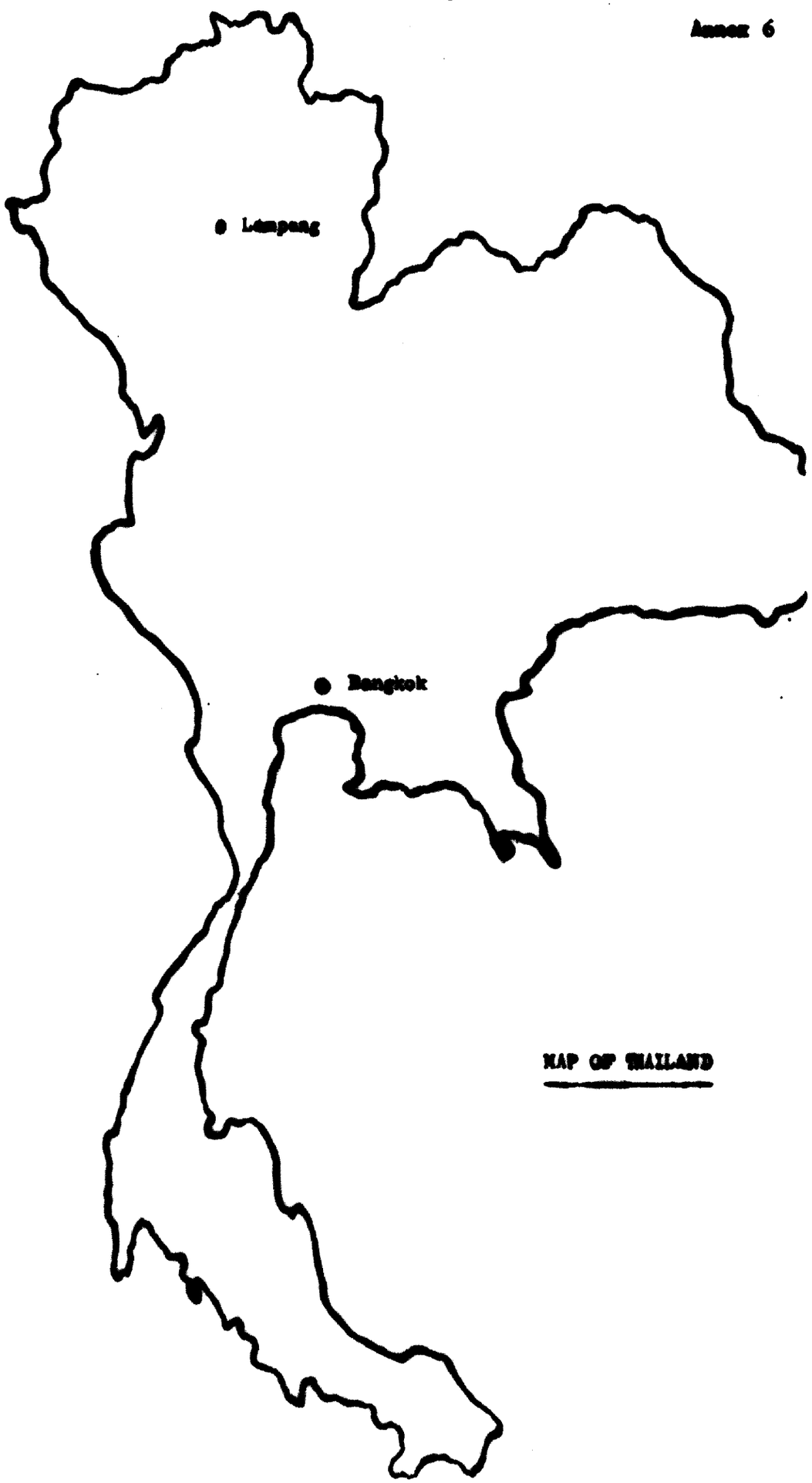
UN Planning Team for the Development of the Northern Region, Thailand, Chiang Mai

Dr. J. Bleger, Project Economist (OTC)

UNDP

Mr. Wali-Shah Wali, Deputy Regional Representative

Annex 6



MAP OF THAILAND

Organisation Chart of ASRCT

Prime Minister

Board

Governor

Research Director-General - Board Secretariat

Central Services

- Administrative Services
- Technical Services

Research Institutes

- Technological Research Institute
- Institute of Development Studies
- Agricultural Research Institute
- Ecological and Environmental Research Institute

Scientific Services

- Thai National Documentation Centre
- Instrument Repair and Calibration Centre
- Centre for Thai National Standard Specifications
- Centre for Thai National Reference Collections

National Building Research and Development Centre

Annex 8

Organisation Chart of TRI

Research Director-General - TRI

Research Services
Production, Packaging and Marketing Unit

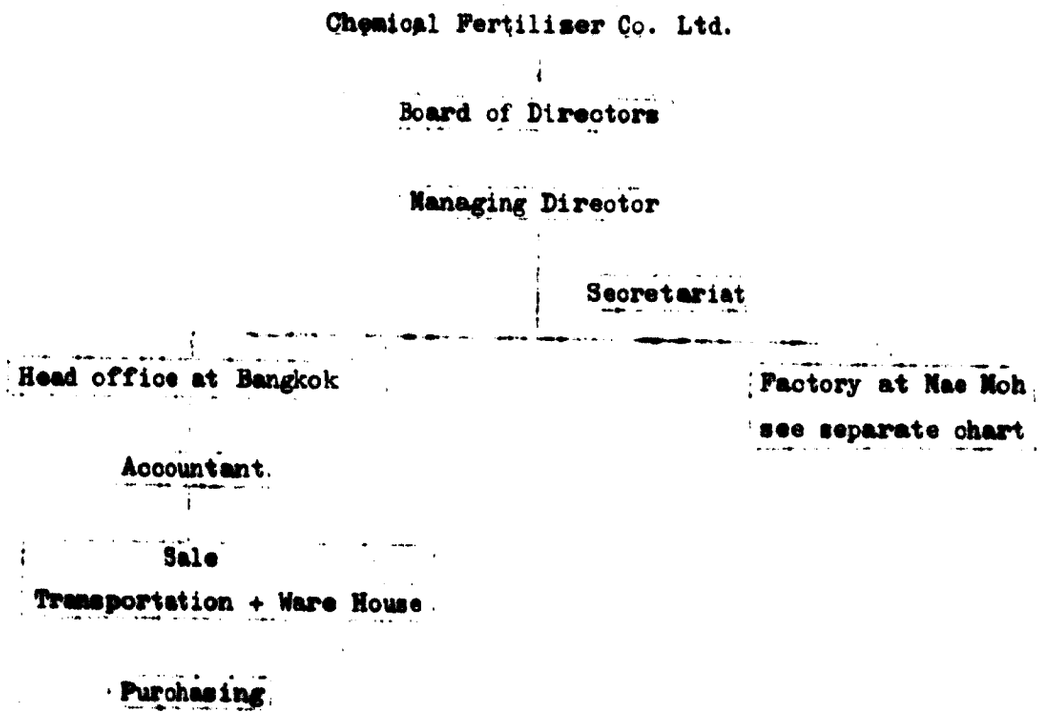
Chemical Technology Group
- Industrial Chemistry Unit
- Industrial Processes Unit
- Analytical Chemistry Unit

Bio-Technology Group
- Food Technology Unit
- Microbiology Unit
- Pharmacology and Pharmaceutical Unit

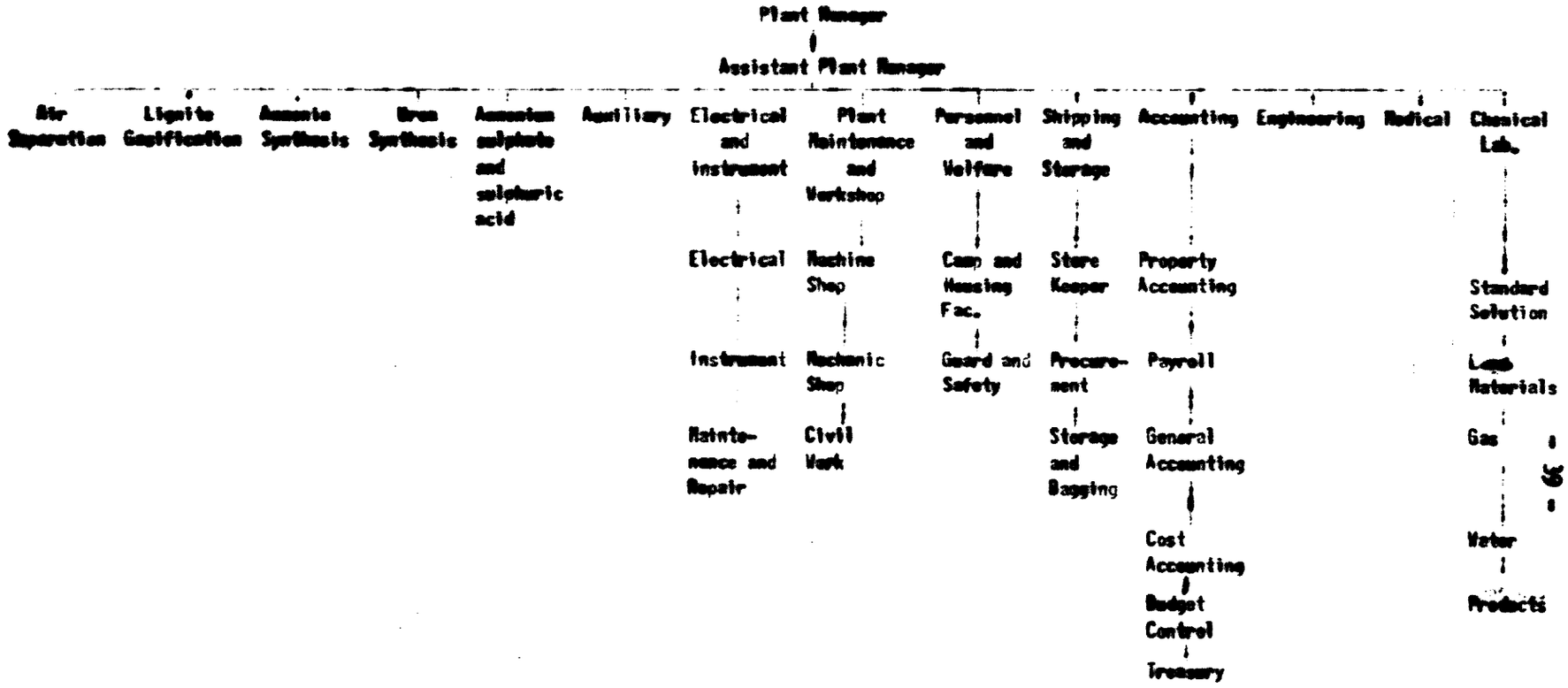
Minerals and Metals Group
- Metallurgy Unit
- Applied Mineralogy Unit
- Cement and Concrete Technology Unit

Physics and Engineering Group
- Physics Unit
- Electrical Engineering Unit
- Structural Engineering Unit
- Properties of Materials Unit

Annex 9


Chemical Fertiliser Co. Ltd.
Board of Directors
Managing Direotor
Secretariat
Head office at Bangkok
Accountant
Sale
Transportation + Ware House
Purchasing
Factory at Mae Moh
see separate chart

Organization Chart of Chemical Fertilizer Plant, Abu Zaabal



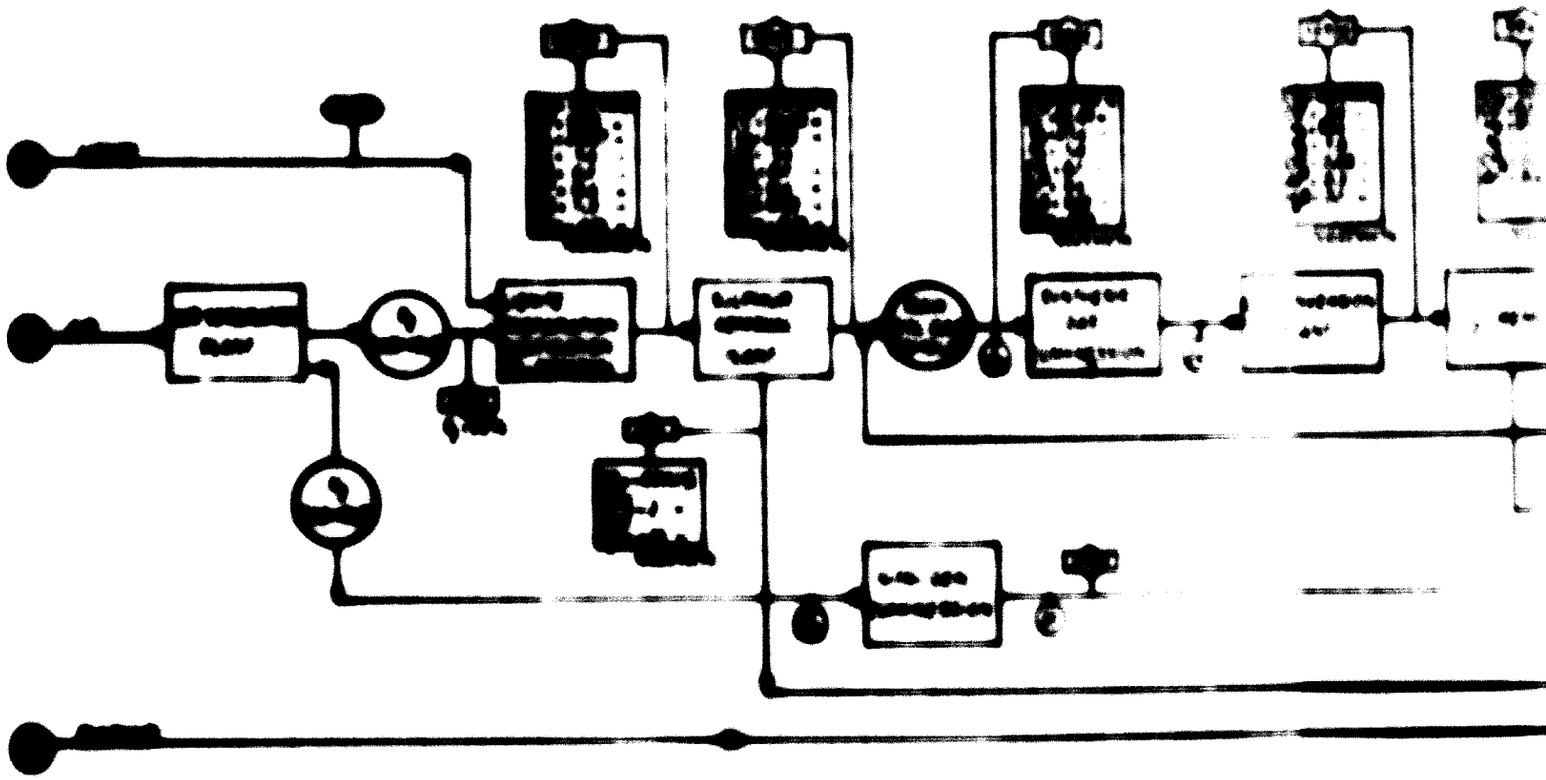
Annex 10

Annex 11

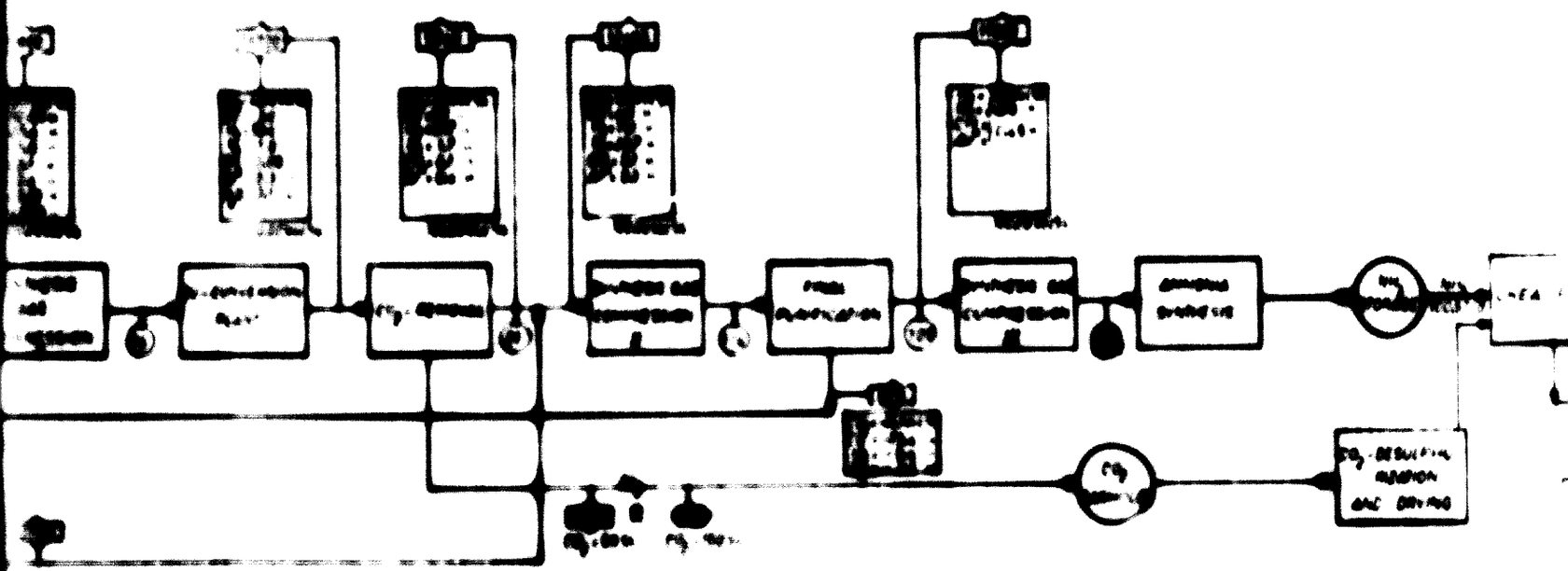
List of names and functions of key technical personnel at fertilizer plant at Mae Moh

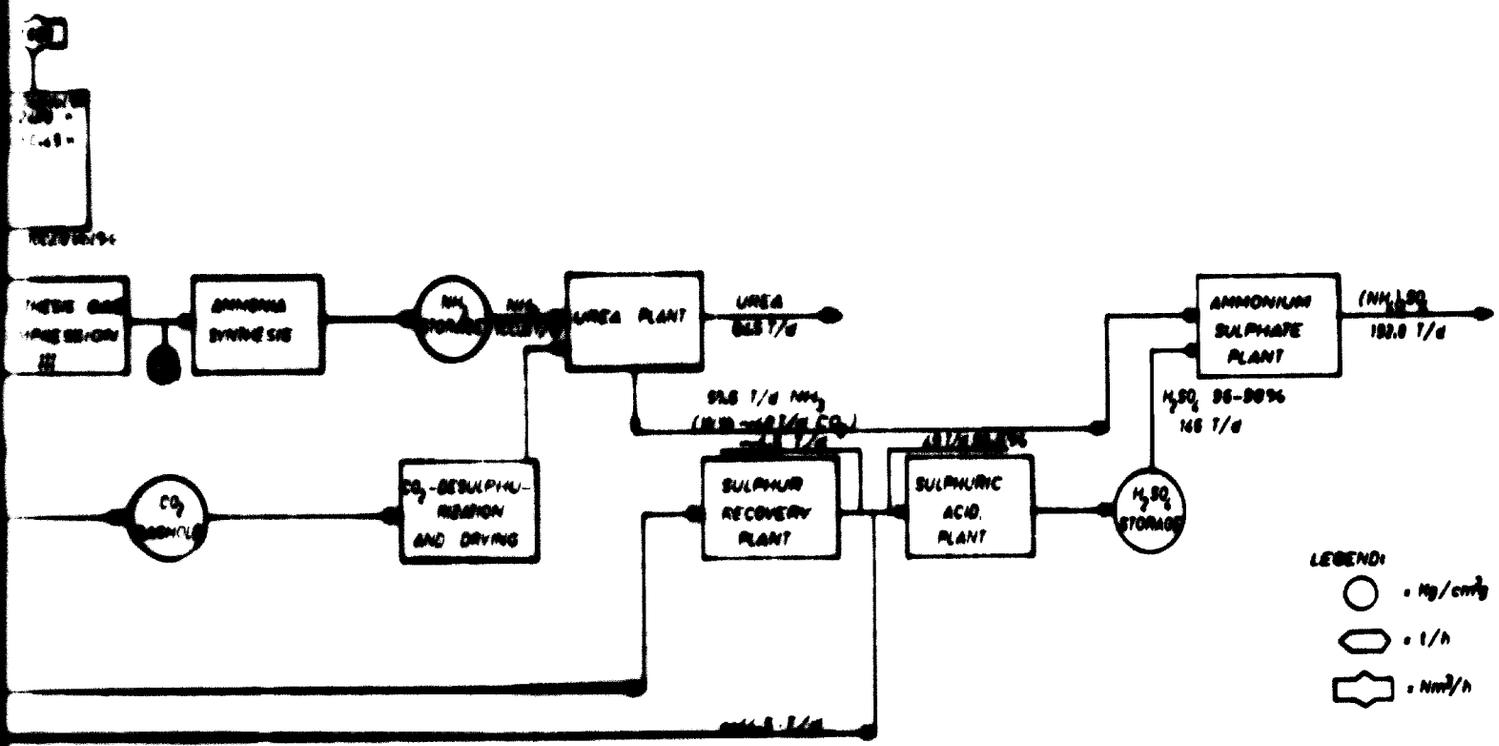
1. Mr. Somnuk Praditthavanij
   Acting Plant Manager
2. Mr. Gumthorn Utrawathipong
   AIR-separation plant
3. Mr. Anant Dejnakitkul
   Chemist
4. Mr. Narlong Khowsomboon
   Accountant
5. Mr. Kapone Nuntakuang
   Electrical engineer - instruments
6. Mr. Pongsit Chaerung Suthpiat
   Ammonia plant
7. Mr. Sabi Boonyanmob
   Chemist
8. Mr. Adul Chaurutama
   Ammonia plant
9. Mr. Khovatchai Liamsamit
   Sulphuric acid and ammonium sulphate plants
10. Mr. Wichani Wirojanairuang
    Urea plant
11. Mr. Thavee Niyomagha
    Mechanical maintenance

FLOW



FLOW DIAGRAM OF FERTILISER COMPLEX
MAE MOH, LAMPANG.




AMMONIA SYNTHESIS SIE
UREA PLANT
UREA 885 T/d
AMMONIUM SULPHATE PLANT
(NH4)2SO4 182.0 T/d
H2SO4 96-98% 146 T/d
CO2 COMPRESS
CO2 - DESULPHU-RISATION AND DRYING
SULPHUR RECOVERY PLANT
SULPHURIC ACID PLANT
H2SO4 STORAGE
LEGEND:
= Kg/cm2g
= t/h
= Nm3/h

SECTION 3

Production Figures for 1970 month by month

prepared by

Engineering Office - Chemical Fertilizer Co. Ltd.

Mae Moh

Engineering Office

Mae Moh, Lampang

PRODUCTION

(tons per/day)

Month: August 1969

Date	NH_3	H_2SO_4	A.S.	Urea	Remark
1	-	20	-	-	
2	-	-	-	-	
3	17	-	-	-	
4	56	-	-	-	
5	43	-	-	-	
6	50	-	20	-	
7	59	-	136	43	
8	57	80	13	21	
9	60	99	165	51	Effective usage of -
10	98	120	159	60	plant.
11	63	139	134	60	NH_3 = 35.90 %
12	66	139	189	67	H_2SO_4 = 38.39 %
13	10	100	70	12	A.S. = 31.47 %
14	-	20	-	-	Urea = 24.01 %
15	-	20	-	-	
16	-	19	-	-	
17	-	18	-	-	
18	1	10	27	-	
19	12	10	97	-	
20	21	31	84	-	
21	90	40	19	11	
22	52	80	138	47	
23	16	20	86	9	
24	19	20	-	-	
25	96	20	-	-	
26	95	60	91	33	
27	99	101	178	66	
28	68	120	102	66	
29	98	40	105	23	
30	98	20	31	-	
31	48	120	132	48	
Total	1,106	1,466	1,881	685	

Engineering Office

Nae Moh, Lampang

PRODUCTION

(tons per/day)

Month: September 1969

Date	NH_3	H_2SO_4	A.S.	Urea	Remark
1	51.40	119.52	110.50	61.300	
2	60.00	119.52	143.50	66.050	
3	55.80	120.72	88.00	70.625	
4	43.70	119.52	68.75	45.675	
5	68.30	119.52	96.30	63.900	
6	71.40	79.68	60.70	66.750	
7	64.70	99.60	88.20	66.575	
8	53.40	-	121.80	66.325	
9	50.10	99.60	76.50	55.550	Effective usage of -
10	50.10	81.60	116.00	56.050	plant.
11	32.672	60.76	98.80	38.225	NH_3 = 41.64 %
12	-	-	-	-	H_2SO_4 = 47.50 %
13	27.10	20.80	-	-	A.S. = 39.33 %
14	13.50	20.92	-	-	Urea = 43.20 %
15	9.70	40.36	15.30	-	
16	39.50	39.76	111.00	-	
17	33.10	99.60	105.50	-	
18	50.80	79.68	127.00	30.100	
19	35.00	79.68	107.05	35.000	
20	31.80	19.92	34.35	28.300	
21	55.80	99.60	113.50	64.425	
22	61.30	99.60	126.10	69.025	
23	54.80	119.52	183.00	65.050	
24	36.70	39.84	104.60	20.350	
25	35.80	19.92	-	-	
26	43.90	19.92	-	-	
27	53.30	60.64	54.00	26.075	
28	27.80	80.28	64.00	35.350	
29	-	19.92	20.00	10.125	
30	44.00	80.48	80.00	30.825	
Total	1,895.472	2,080.56	2,274.65	1,095.050	

Engineering Office

Mae Moh, Lampang

PRODUCTION

(tons per/day)

Month: October 1969

Date	NH_3	H_2SO_4	A.S.	Urea	Remark
1	33.622	59.760	97.000	36.800	
2	51.416	80.400	107.000	26.625	
3	38.396	56.700	113.200	-	
4	-	19.920	-	-	
5	-	19.920	-	-	
6	-	19.920	-	-	
7	-	26.540	-	-	
8	48.279	59.760	77.800	34.050	
9	56.363	99.600	129.600	60.875	Effective usage of -
10	44.300	59.760	76.450	30.525	plant.
11	55.000	79.680	102.450	55.275	NH_3 = 37.81 %
12	31.735	19.920	90.300	11.775	H_2SO_4 = 40.63 %
13	57.540	19.920	74.700	-	A.S. = 40.19 %
14	53.756	80.600	97.700	54.125	Urea = 33.56 %
15	51.530	99.600	143.000	74.750	
16	32.438	39.840	66.650	18.200	
17	51.804	79.600	115.800	53.400	
18	44.580	19.920	41.500	9.650	
19	58.376	19.920	-	-	
20	53.616	39.840	-	-	
21	47.434	79.680	102.800	75.285	
22	24.886	39.840	75.600	2.750	
23	52.116	119.520	109.150	60.975	
24	50.023	119.520	162.000	75.250	
25	35.208	119.520	156.700	65.700	
26	39.195	19.980	85.700	4.850	
27	51.541	99.600	98.600	55.190	
28	49.192	120.000	81.900	42.900	
29	21.697	99.760	85.850	7.850	
30	-	19.980	108.350	5.900	
31	28.867	39.840	123.000	-	
Total	1,177.950	1,839.080	2,402.800	879.000	

Engineering Office

Mae Moh, Lampang

PRODUCTION

(tons per/day)

Month: November 1969

Date	NH_3	H_2SO_4	A.S.	Urea	Remark
1	51.736	119.520	126.500	48.850	
2	34.044	99.600	32.000	17.450	
3	56.752	79.680	126.500	70.725	
4	42.031	19.920	55.900	10.975	
5	42.601	39.840	-	-	
6	30.918	19.920	-	-	
7	36.884	79.680	27.550	11.850	
8	62.308	119.520	136.500	78.250	
9	59.070	99.600	155.000	79.550	Effective usage of -
10	64.599	120.440	181.300	90.025	plant.
11	53.708	119.520	172.150	72.350	NH_3 = 39.66 %
12	54.821	60.880	127.550	-	H_2SO_4 = 42.48 %
13	62 400	79.680	134.900	-	A.S. = 37.48 %
14	59.323	40.640	131.100	-	Urea = 35.84 %
15	62.803	120.440	133.000	50.725	
16	60.864	99.600	77.400	64.175	
17	61.857	101.760	86.600	65.375	
18	59.722	119.520	85.500	70.300	
19	58.218	120.720	95.500	65.775	
20	26.437	79.680	67.500	20.400	
21	74.100	120.520	149.250	85.975	
22	2.700	-	63.200	6.025	
23	-	-	-	-	
24	-	-	-	-	
25	-	-	-	-	
26	-	-	-	-	
27	-	-	-	-	
28	-	-	-	-	
29	40.829	-	-	-	
30	37.169	-	-	-	
Total	1,195.894	1,860.680	2,167.900	908.575	

Engineering Office
Mae Moh, Lampang

PRODUCTION
(tons per/day)

Month: December 1969

Date	NH_3	H_2SO_4	A.S.	Urea	Remark
1	54.716	79.680	45.650	40.675	
2	29.984	40.720	66.000	31.275	
3	58.060	119.520	152.500	71.250	
4	57.585	100.400	142.500	66.925	
5	14.072	21.120	68.300	13.175	
6	31.841	79.680	37.200	15.575	
7	55.112	99.600	114.500	47.300	
8	59.059	82.190	130.200	56.425	
9	66.117	120.720	113.800	52.950	Effective usage of -
10	75.608	99.600	149.000	65.675	plant.
11	72.263	121.250	132.800	59.850	NH_3 . = 53.75 %
12	59.636	99.600	133.100	56.625	
13	58.274	80.760	75.100	29.350	H_2SO_4 = 58.95 %
14	63.784	119.520	138.000	62.475	A.S. = 54.99 %
15	62.872	100. 60	137.500	60.175	Urea = 57.93 %
16	38.622	59.760	84.500	29.900	
17	65.067	99.600	101.000	50.875	
18	56.008	99.600	144.000	58.675	
19	39.887	60.880	112.800	39.250	
20	-	-	-	-	
21	4.247	19.920	-	-	
22	37.066	21.520	-	-	
23	65.702	99.600	70.700	52.075	
24	60.261	80.420	151.000	67.750	
25	59.760	99.600	115.500	67.650	
26	60.043	121.120	156.800	69.550	
27	62.333	100.280	134.700	69.175	
28	62.405	119.520	143.800	69.090	
29	83.499	101.000	133.300	71.950	
30	80.339	100.520	138.300	71.300	
31	80.273	119.580	163.800	70.500	
Total	1,674.495	2,667.980	3,206.350	1,511.400	

Engineering Office
Mae Moh, Lampang

PRODUCTION
(tons per/day)

Month: January 1970

Date	NH_3	H_2SO_4	A.S.	Urea	Remark:
1	67.811	79.680	105.800	60.050	
2	84.626	-	-	-	
3	29.932	21.000	-	-	
4	41.302	99.600	76.300	34.200	
5	76.067	121.600	167.000	82.650	
6	92.588	119.520	184.00	88.400	
7	84.671	119.520	194.500	87.250	
8	-	20.720	42.400	4.200	
9	14.543	60.390	-	-	Effective usage of -
10	89.014	120.600	132.100	65.900	plant.
11	93.777	119.520	193.500	88.950	NH_3 = 61.50 %
12	83.329	139.440	192.400	85.625	H_2SO_4 = 67.83 %
13	52.770	101.720	113.600	51.375	A.S. = 60.29 %
14	60.487	139.440	141.000	71.250	Urea = 63.79 %
15	63.683	119.320	136.500	70.550	
16	60.971	120.920	148.900	70.725	
17	81.925	120.600	155.100	70.375	
18	44.217	119.520	97.500	47.800	
19	59.971	121.120	106.500	45.050	
20	61.468	100.800	151.500	57.650	
21	58.788	120.160	126.000	61.075	
22	64.595	120.720	132.400	62.650	
23	61.931	100.800	150.100	68.275	
24	53.839	120.600	50.500	9.750	
25	62.970	19.920	-	-	
26	47.111	120.560	79.700	42.000	
27	61.174	99.600	151.500	66 725	
28	61.134	101.200	151.000	68.585	
29	62.000	99.600	140.300	70.550	
30	65.294	101.200	139.200	70.500	
31	63.906	100.400	136.000	68.175	
Total	1,915.902	3,069.790	3,603.300	1,671.025	

Engineering Office

Mae Moh, Lampang

PRODUCTION

(tons per/day)

Month: February 1970

Date	NH_3	H_2SO_4	A.S.	Urea	Remark
1	62.206	99.600	152.000	69.225	
2	51.491	120.800	151.000	64.775	
3	-	-	-	-	
4	4.166	-	-	-	
5	30.628	41.840	-	-	
6	-	0.800	-	-	
7	-	19.920	-	-	
8	-	9.960	-	-	
9	-	8.300	-	-	Effective usage of -
10	41.093	39.840	40.200	-	plant.
11	60.444	39.840	93.900	31.275	NH_3 = 45 %
12	61.092	99.600	141.700	62.825	
13	61.308	120.320	120.000	63.875	H_2SO_4 = 47 %
14	61.457	100.800	142.000	62.325	A.S. = 46 %
15	62.028	99.600	121.300	62.225	Urea = 47 %
16	60.484	99.600	146.200	63.650	
17	60.185	100.800	103.500	63.875	
18	60.062	99.600	146.500	62.575	
19	59.802	21.520	50.400	9.475	
20	61.765	19.920	-	-	
21	60.311	81.320	24.800	25.975	
22	58.217	99.600	164.000	69.475	
23	61.305	101.200	138.500	70.675	
24	58.096	100.800	127.900	69.975	
25	57.465	100.800	162.500	67.900	
26	56.598	100.880	133.200	71.700	
27	52.119	99.600	160.900	69.100	
28	55.414	82.480	154.800	57.075	
29	-	-	-	-	
Total	1,257.736	1,909.340	2,482.700	1,119.850	

Engineering Office

Mae Moh, Lampang

PRODUCTION

(tons per/day)

Month: March 1970

Date	NH_3	H_2SO_4	A.S.	Urea	Remark
1	58.899	99.600	138.800	55.975	
2	21.669	19.920	96.400	30.525	
3	-	-	-	-	
4	-	-	-	-	
5	-	39.840	-	-	
6	35.381	101.200	-	-	
7	58.537	64.880	-	-	
8	47.981	-	-	-	
9	58.705	100.800	97.000	59.275	Effective usage of -
10	56.773	100.400	134.160	69.000	plant.
11	60.776	100.520	148.000	71.500	NH_3 = 20 %
12	60.159	101.200	145.900	70.850	
13	56.682	100.800	139.500	67.750	H_2SO_4 = 28 %
14	57.799	81.280	157.800	71.775	A.S. = 26 %
15	55.437	99.600	91.300	28.475	Urea = 27 %
16	59.438	101.200	117.500	68.825	
17	60.359	80.480	196.800	84.850	
18	58.432	62.160	80.900	26.825	
19	57.856	-	-	-	
20	21.666	-	-	-	
21	-	-	-	-	
22	-	-	-	-	
23	-	-	-	-	
24	-	-	-	-	
25	-	-	-	-	
26	-	-	-	-	
27	-	-	-	-	
28	-	-	-	-	
29	-	-	-	-	
30	-	-	-	-	
31	-	-	-	-	
Total	885.989	1,253.868	1,544.060	705.675	

Engineering Office
Nam Nam, Lampang

PRODUCTION
(tons per/day)

Month: April 1970

Date	NH_3	H_2SO_4	Urea	A.S.	Remark
1	-	-	-	-	
2	-	-	-	-	
3	-	-	-	-	
4	-	-	-	-	
5	-	-	-	-	
6	-	-	-	-	
7	18.986	61.360	-	-	
8	60.540	101.600	-	-	
9	60.619	101.200	66.575	74.400	Effective usage of plant.
10	59.147	100.800	66.125	83.000	
11	57.269	101.600	66.950	83.500	
12	34.500	40.240	36.125	77.000	NH_3 = 36 %
13	59.830	80.480	69.200	80.000	H_2SO_4 = 36 %
14	63.144	90.440	67.000	77.800	Urea = 38 %
15	63.054	21.520	8.050	79.500	A.S. = 29 %
16	34.414	16.600	4.025	10.000	
17	44.547	62.160	43.425	39.900	
18	60.471	81.580	75.075	111.100	
19	59.946	101.200	71.150	120.000	
20	47.516	101.600	64.050	121.500	
21	58.688	82.080	65.475	115.500	
22	55.135	41.040	16.375	66.400	
23	59.373	11.960	-	-	
24	17.640	41.040	20.075	51.300	
25	-	-	7.825	-	
26	-	-	-	35.500	
27	13.446	41.240	-	49.200	
28	54.205	99.500	58.775	99.800	
29	56.036	99.680	69.000	141.900	
30	56.531	79.680	75.675	133.900	
Total	1,095.117	1,559.580	953.350	1,696.400	

Engineering Office

Nam Ngum, Lampam [redacted]

(tons per/day)

Months May 1978

Date	NH_3	H_2SO	Urea	A.N.	
1	57.652	119.520	73.710	136.000	
2	57.551	119.520	68.095	129.300	
3	57.[illegible]	119.520	68.[illegible]	[illegible].000	
4	56.211	123.120	76.805	11[illegible].000	
5	56.090	19.920	15.17[illegible]	[illegible].700	
6	8[illegible].201	9.[illegible]50	-	-	
7	[illegible].399	-	-	-	
8	41.799	139.[illegible]10	[illegible].795	72.600	
9	40.159	901.[illegible]20	37.000	137.000	Effective range of -
10	10.101	39.640	12.[illegible]	[illegible].700	plant.
11	-	-	-	-	NH_3 - 37 %
12	-	-	-	-	H_2SO - 97 %
13	-	-	-	-	Urea - 99 %
14	-	-	-	-	A.N. - 33 %
15	-	-	-	-	
16	32.533	-	-	-	
17	50.[illegible]01	-	-	-	
18	59.431	99.600	12.050	17.000	
19	61.068	99.600	38.640	133.000	
20	56.605	99.[illegible]00	[illegible].350	128.000	
21	63.500	79.000	41.[illegible]05	94.[illegible]00	
22	23.211	51.[illegible]30	13.[illegible]95	113.000	
23	[illegible].835	60.760	16.[illegible]05	61.[illegible]00	
24	17.[illegible]59	79.600	19.[illegible]05	96.[illegible]00	
25	34.57[illegible]	99.740	18.[illegible]00	[illegible].[illegible]00	
26	52.852	79.[illegible]00	[illegible].475	79.[illegible]00	
27	57.230	99.[illegible]00	06.[illegible]75	150.[illegible]00	
28	56.999	99.900	6.[illegible]75	50.[illegible]00	
29	99.343	-	-	-	
30	0.138	41.[illegible]40	-	-	
31	53.033	84.930	-	-	
Total	1,151.850	1,[illegible].070	9[illegible].695	1,[illegible].200	

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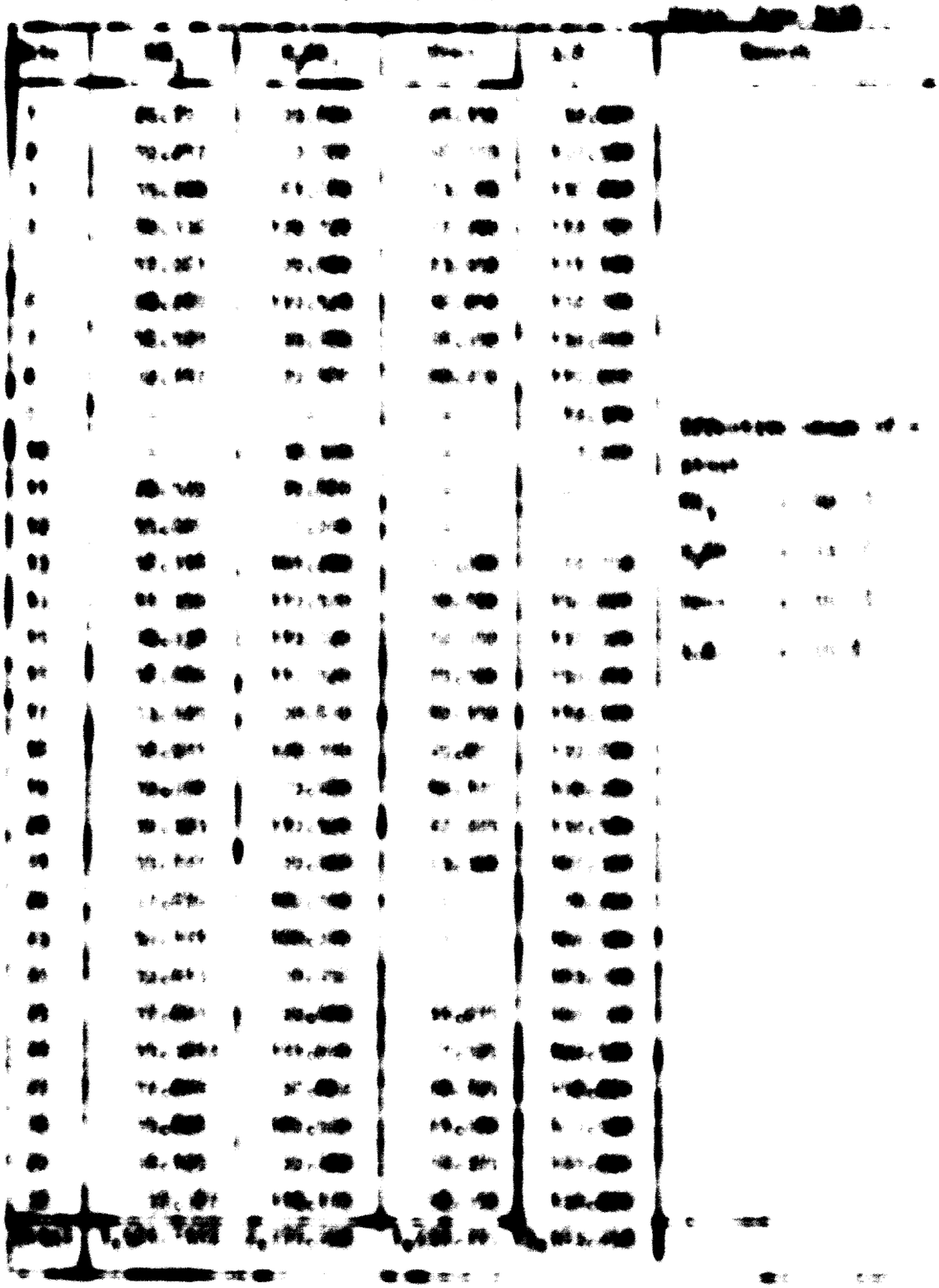

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Month: July 1970.

[illegible]	[illegible]	[illegible]	[illegible]	A.G.	Remarks
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	-	[illegible]	-		
[illegible]	-	[illegible]	-	-	
[illegible]	[illegible]	[illegible]		-	
[illegible]	[illegible]	[illegible]	-	-	
[illegible]	[illegible]	[illegible]	-	[illegible]	
[illegible]	[illegible]		-	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Effective usage of plant.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] - [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] - [illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	-	-	[illegible]	[illegible]	
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	-	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Total	[illegible]	[illegible]	[illegible]	[illegible]	

Engineering Office

Nae Noh, Lampang.

PRODUCTION

(tons per/day)

Month: August 1970.

Date	NH_3	H_2SO_4	Urea	A.S.	Remark
1	57.150	107.731	66.375	130.000	
2	57.466	119.520	63.900	130.500	
3	60.716	117.040	66.300	115.900	
4	56.460	125.850	8.975	47.600	
5	32.824	107.020	-	-	
6	-	77.320	-	-	
7	-	63.107	-	-	
8	57.601	114.537	27.675	45.200	
9	62.407	122.482	62.425	145.100	Effective usage of -
10	56.984	107.822	61.125	130.400	plant.
11	55.244	57.877	45.300	99.000	NH_3 = 41 %
12	57.062	126.261	7.650	15.200	H_2SO_4 = 59 %
13	40.750	95.104	11.325	1.100	Urea = 41 %
14	50.265	95.006	44.475	93.200	A.S. = 36 %
15	60.912	134.028	67.775	131.000	
16	61.840	89.790	63.125	157.000	
17	52.924	119.520	52.675	106.000	
18	57.568	126.140	76.250	145.500	
19	56.722	111.460	74.900	145.700	
20	61.412	111.100	68.800	119.400	
21	16.851	31.345	19.250	51.200	
22	-	-	-	-	
23	-	-	-	-	
24	-	-	-	-	
25	-	82.304	-	-	
26	18.131	90.643	-	-	
27	58.526	65.740	-	-	
28	89.318	19.920	3.975	-	
29	57.270	85.220	63.150	89.300	
30	57.240	99.500	66.450	101.000	
31	58.049	80.880	43.000	125.000	
Total	1,807.700	2,684.347	1,064.875	2,124.500	

Engineering Office
Mae Moh, Lampang.

PRODUCTION
(tons per/day)

Month: September 1970

Date	NH_3	H_2SO_4	Urea	A.S.	Remark
1	59.990	96.694	68.850	114.000	
2	61.133	104.249	62.875	151.500	
3	49.930	70.920	68.975	119.500	
4	54.455	125.064	70.575	117.800	
5	58.022	112.739	67.475	125.100	
6	59.560	93.410	54.900	135.300	
7	58.323	-	18.825	62.800	
8	59.692	39.840	-	-	
9	14.339	113.644	-	-	Effective usage of -
10	21.162	105.685	-	-	plant.
11	57.333	104.459	43.725	76.000	NH_3 - 47 %
12	56.147	100.400	72.400	166.500	H_2SO_4 - 67 %
13	52.093	112.660	72.575	142.500	Urea - 52 %
14	52.896	102.200	71.000	131.000	A.S. - 44 %
15	55.942	93.637	65.775	118.500	
16	59.034	92.586	24.625	83.300	
17	58.184	103.490	-	-	
18	58.760	103.676	29.000	43.500	
19	55.714	104.950	64.025	125.500	
20	57.433	99.600	63.600	148.700	
21	59.927	119.520	63.225	134.500	
22	54.743	93.691	59.625	100.150	
23	57.847	123.577	56.775	110.000	
24	55.275	105.449	60.225	98.800	
25	55.890	107.196	58.750	60.500	
26	54.975	95.408	63.450	103.000	
27	8.974	93.676	16.040	49.300	
28	-	109.600	-	-	
29	-	107.630	-	-	
30	-	99.600	-	-	
Total	1,407.773	2,935.330	1,307.300	2,585.950	

Engineering Office

Nam Ngum, Lampang [redacted]

(tons per day)

Month: October 1970

Date	NH_3	H_2SO_4	Urea	A.S.	Remark
1	-	113.385	-	19.20	
2	-	56.511	-	105.20	
3	27.000	104.244	-	120.20	
4	60.734	73.217	-	45.90	
5	57.767	90.000	44.475	66.90	
6	57.041	116.204	40.950	149.60	
7	1.091	90.[illegible]0	4.[illegible]00	[illegible]4.00	
8	33.564	34.[illegible]02	22.[illegible]00	110.00	
9	50.901	98.0[illegible]	1.750	123.00	Effective range of -
10	16.953	111.121	2.150	65.95	p.ash
11	53.510	29.951	-	-	NH_3 - 40 %
12	96.955	-		-	H_2SO_4 - 58 %
13	59.106	106.784	42.[illegible]75	57.50	Urea - 40 %
14	59.404	104.[illegible]04	40.115	134.00	A.S - 46 %
15	61.101	111.[illegible]39	40.875	123.00	
16	1.903	93.4[illegible]3	1.[illegible]00	69.20	
17	-	9[illegible].700	-	-	
18	-	[illegible]4.[illegible]03	-	-	
19	35.579	-	-	-	
20	47.000	[illegible]7.150	-	-	
21	58.479	[illegible]3.0[illegible]2	43.[illegible]75	[illegible]7.50	
22	54.571	1[illegible].161	39.505	148.50	
23	56.470	[illegible]8.771	40.[illegible]25	91.50	
24	[illegible]6.176	1[illegible].[illegible]29	[illegible].[illegible]25	156.50	
25	55.012	[illegible]9.[illegible]65	41.[illegible]25	109.50	
26	56.603	[illegible]3.[illegible]87	[illegible].[illegible]50	[illegible]6.50	
27	[illegible]7.[illegible]07	[illegible]1.[illegible]00	[illegible].[illegible]00	[illegible].50	
28	58.093	[illegible]1.[illegible]15	[illegible].[illegible]50	[illegible]0.00	
29	[illegible]1.[illegible]00	[illegible]5.[illegible]53	[illegible].[illegible]25	[illegible]0.50	
30	[illegible].[illegible]03	[illegible]0[illegible].[illegible]11	[illegible].[illegible]75	[illegible]1.50	
31	[illegible]7.[illegible]11	[illegible]1[illegible].[illegible]06	[illegible].[illegible]00	[illegible]6.00	
Total	[illegible],[illegible]06.[illegible]00	[illegible],[illegible]9[illegible].[illegible]10	[illegible],[illegible]0[illegible].[illegible]00	[illegible],[illegible]0[illegible].[illegible]95	

Engineering Office

[redacted]

(1mm = [redacted] mg)

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
1	[redacted]	[redacted]	[redacted]	[redacted]	
2	[redacted]	[redacted]	[redacted]	[redacted]	
3	[redacted]	[redacted]	[redacted]	[redacted]	
4	[redacted]	[redacted]	-	-	
5	[redacted]	[redacted]	-	-	
6	[redacted]	[redacted]	[redacted]	[redacted]	
7	[redacted]	[redacted]	[redacted]	[redacted]	
8	[redacted]	[redacted]	[redacted]	[redacted]	
9	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
10	[redacted]	[redacted]	[redacted]	[redacted]	
11	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
12	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
13	[redacted]	[redacted]	-	-	
14	[redacted]	[redacted]	-	-	[redacted]
15	-	[redacted]	-	-	[redacted]
16	-	[redacted]	-	-	
17	-	[redacted]	-		
18	-	[redacted]		-	
19	[redacted]	[redacted]	-	-	
20	[redacted]	[redacted]	[redacted]	[redacted]	
21	[redacted]	[redacted]	[redacted]	[redacted]	
22	[redacted]	[redacted]	[redacted]	[redacted]	
23	[redacted]	[redacted]	[redacted]	[redacted]	
24	[redacted]	[redacted]	[redacted]	[redacted]	
25	[redacted]	[redacted]	[redacted]	[redacted]	
26	-	-	-	-	
27	-	-	-	-	
28	-	-	-	-	
29	-	-	-	-	
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	

Engineering Office

Tea Estate, Langkawi.

[redacted]

(Loose reading)

Month: December 1970.

Date	[illegible]	[illegible]	Urea	A.S.	Remark
1	-	-	-	-	
2	-	-	-	-	
3	-	-	-	-	
4	-	-	-	-	
5	-	-	-	-	
6	[illegible]	[illegible]	-	-	
7	[illegible]	[illegible]		-	
8	-	[illegible]	-	[illegible]	
9	-	[illegible]	-	[illegible]	Withdrawn usage of -
10	-	[illegible]	-	[illegible]	Limit.
11	[illegible]	-	-	[illegible]	NH_3 - 21
12	[illegible]	[illegible]	[illegible]	[illegible]	K_2SO_4 - 41
13	[illegible]	[illegible]	[illegible]	[illegible]	Urea - 16
14	[illegible]	[illegible]	[illegible]	[illegible]	A.S. - 21
15	[illegible]	[illegible]	[illegible]	[illegible]	
16	[illegible]	[illegible]	[illegible]	[illegible]	
17	[illegible]	[illegible]	[illegible]	[illegible]	
18	[illegible]	[illegible]	[illegible]	[illegible]	
19	[illegible]	[illegible]	[illegible]	[illegible]	
20		[illegible]		-	
21	[illegible]	[illegible]	[illegible]		
22	[illegible]	[illegible]	[illegible]	[illegible]	
23	[illegible]	[illegible]	[illegible]	[illegible]	
24	-	[illegible]	-	[illegible]	
25	-	[illegible]	-	-	
26	-	[illegible]	-	-	
27		[illegible]	-	-	
28	-	[illegible]	-		
29	-		-	-	
30	-		-	-	
31	-	[illegible]	-	-	
Total	[illegible]	[illegible]	[illegible]	[illegible]	

Annex 37

DAMAGES OR TROUBLES OF FERTILISER PLANT

FLAX MOR, LJUNGBY

Engineering Office
Hsu Hsin, Lanyang

Damage or trouble of the fertilizer plant for Feb

Month: February 1970

Date	Plant	Cause of damage or trouble	Remarks
1			
2			
3	Gasification	Over pressure in synthesis gas line to gasholder. (11.45 h.)	Ammonia, Urea, Ammonium sulphate and H_2SO_4 plant shut down.
4	Power Station	Turbine line fault (1.16 h.)	Shut down the whole plant.
5	Gasification	Booster blower I, II and III defected. (1.20 p.m)	Gasification Repair in the plant.
6	"	" "	1. Cleaning the boilers.
7	"	" "	2. Cleaning the washer.
8	"	" "	3. Cleaning valves of the spray cooler
9	"	" "	4. Repair the booster blowers.
10	"	(Restart-up again on 1.35 p.m.)	Gas Separation 1. Repair underground cooling.
11			2. Change the cooler 3rd stage of air turbo compressor.
12			Gasification
13			1. Repair underground cooling.
14			
15			
16			
17			
18			
19	Urea Synthesis	Liquid NH_3 not enough for operated. (6.35 a.m)	Ammonium Sulphate, Sulphuric Acid plant shut down.
20	"	" " "	Repair of the plant
21	"	(Restart-up again on (5.05 p.m)	1. Cleaning the valves of CO_2 Compressor.
22			
23			
24	Grinding and Drying	Raw Lignite conveyor motor main bearing defected. (5.05 h.)	
25			
26			

Engineering Office
Nam Hab, Lampang

Summary of troubles of the fertilizer plant Nam Hab

Month: March 1970

Date	Plant	Cause of damage or trouble	Remarks
1			
2	Gasification	Slag blocked in Gasifier (5.00 p.m.)	Shut down the whole plant except Air Separation plant.
3	"	" " "	
4	"	" " "	
5	"	" " "	
6	"	(Restart-up again on (1.05 p.m.)	
7			
8	Gasification	Channel At Overhead in feeding finished coal to hopper causing gas break down (1.50 h.)	
9			
10			
11			
12			
13	CO_2-Removal	Turbine shut down by automatic. (2.20 h.)	Urea, Ammonium Sulphate plant shut down.
14			
15	CO_2-Removal	Turbine shut down by automatic. (8.35 h.)	Urea, Ammonium Sulphate plant shut down.
16			
17			
18	Urea Synthesis	For repair Urea Reactor (R_2) (11.35 a.m.)	Ammonium Sulphate, Sulphuric Acid plant shut down.
19			
20	Gasification	Shut down for repair in the plant (1.30 p.m.)	Ammonia plant shut down.
21			
22			

Engineering Office
Nam Pong, Lampang

Records of trouble of the Auxiliary plant for the

Month March 1970
(continued)

Date	Plant	Cause of stange or trouble	Remarks
23	Substation I	D.C.earth fault in Board 91 P. (2.9 p.m.) (Air Separation plant, Restart again on 3.9 p.m.)	Air Separation plant shut down.
24			
25			
26			
27			
28			
29			
30			

Engineering Office
Kuo Kuang Company

[illegible] April 1970

No.	Plant	[illegible]	Remarks
1			
2			
3			
	[illegible]	[illegible]	[illegible]
5			
6			
7			
8			
9			
10			
11			
12	[illegible]	[illegible]	[illegible]
13			
14			
15	[illegible]	[illegible]	[illegible]
16	[illegible]	[illegible]	[illegible]
17			
18			
19			
20	[illegible]	[illegible]	
21	[illegible]	[illegible]	
22			
23	[illegible]	[illegible]	[illegible]
24			

Engineering Office

Nam Ngeb, Lampang

Remarks of troubles of the fertilizer plant Nam Ngeb

Months April 1970 (continued)

Date	Plant	Cause of change or trouble	Remarks
24	Gasification	Slag blocked in Gasifier (5.15 p.m.)	The whole plant shut down except Air Separation
25	"	" "	
26	"	" "	
27	"	(started again on 7.30 p.m.)	
28	Gasification	Back fire in Gasifier (0.35h)	Ammonia, Urea and A.S. plant Reduce Load.
29			
30			

Engineering office
New Delhi, Longwa

[redacted]

Date	Plant	[redacted]	[redacted]
1			
2			
3			
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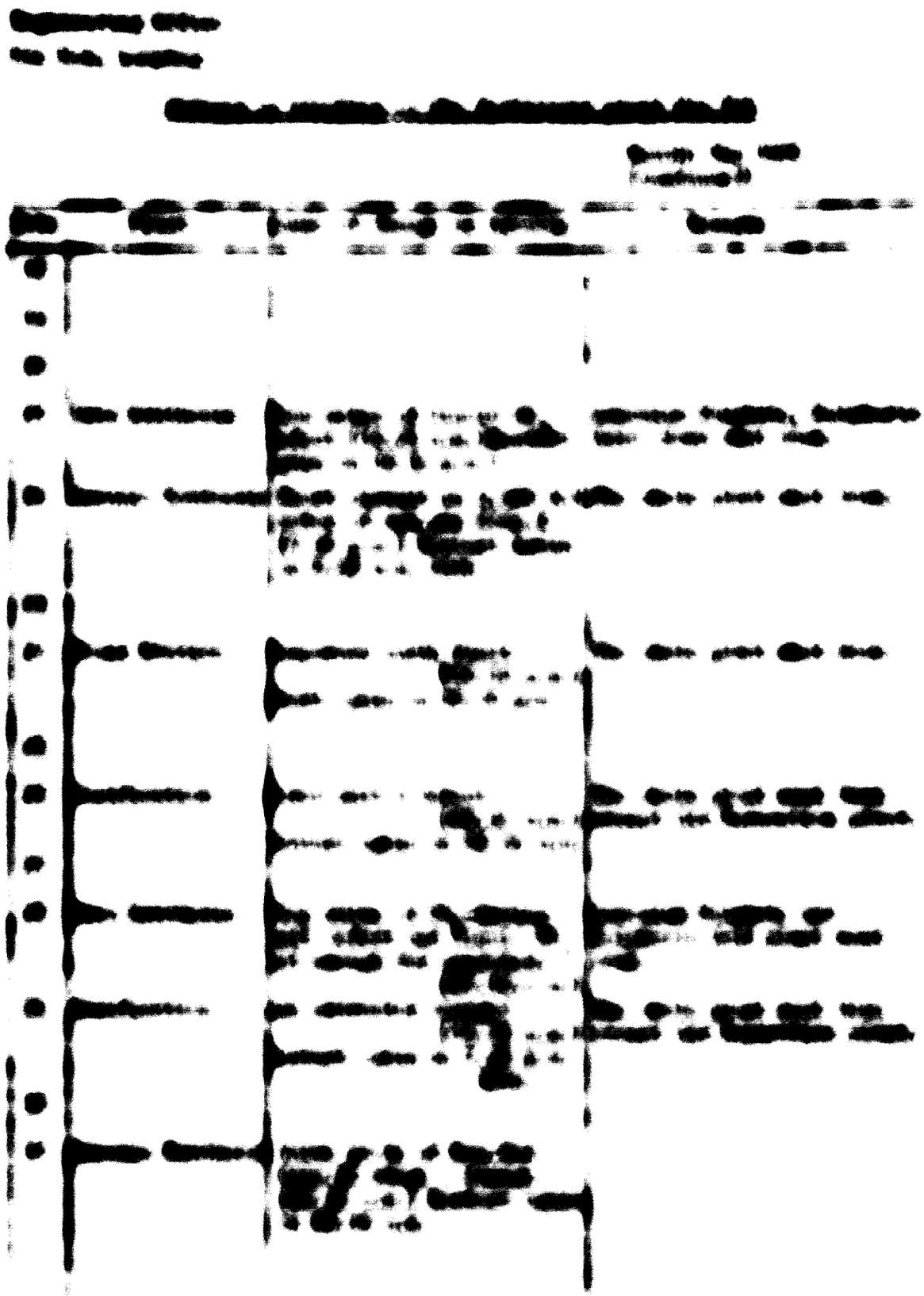
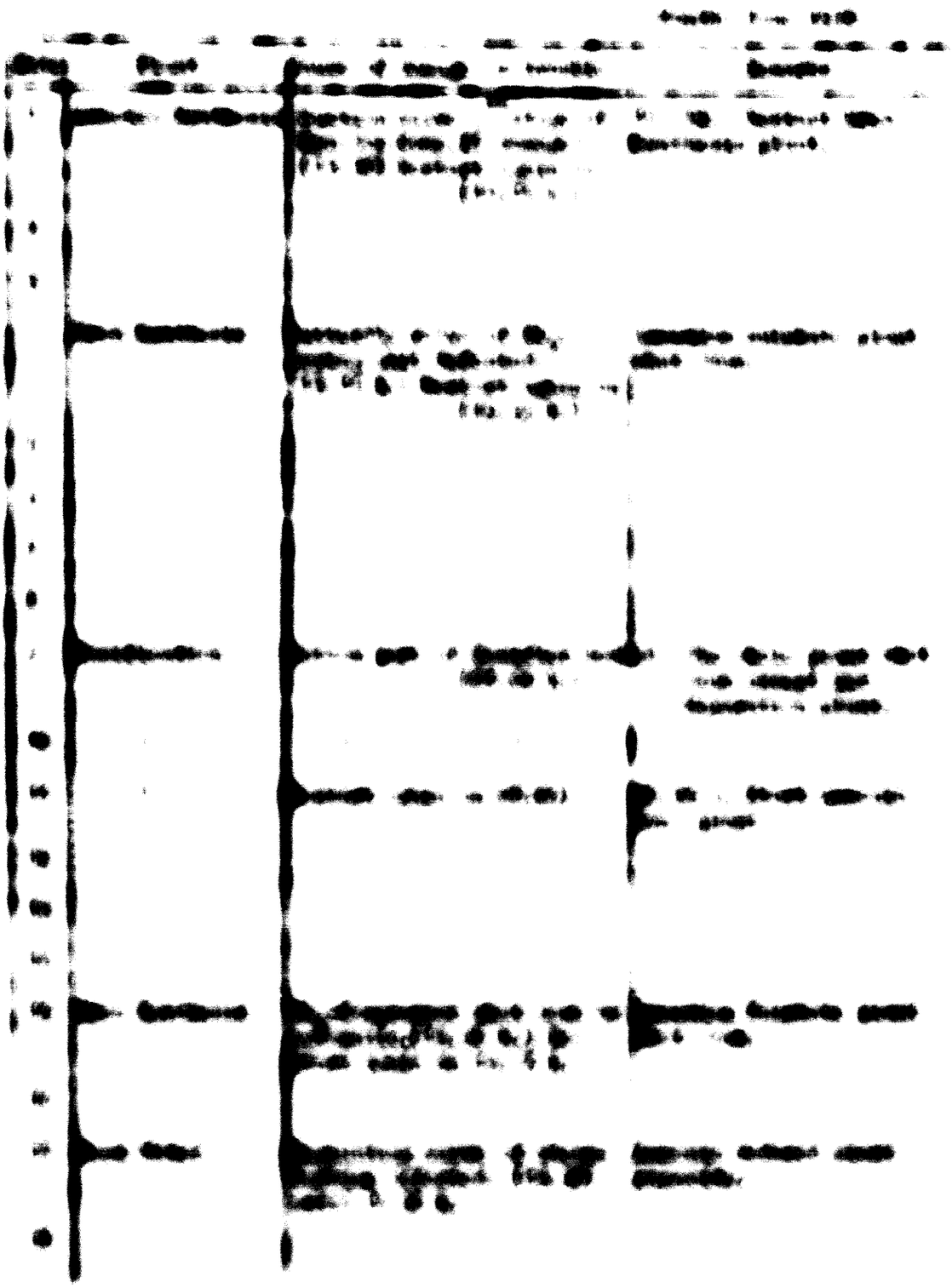
9			
10			
11			
12			
13			
14			
15			
16			
17			





Engineering Office
Hua Hin, Lampang

Damages or troubles of the fertilizer plant Hua Hin

Month: June 1970
(continued)

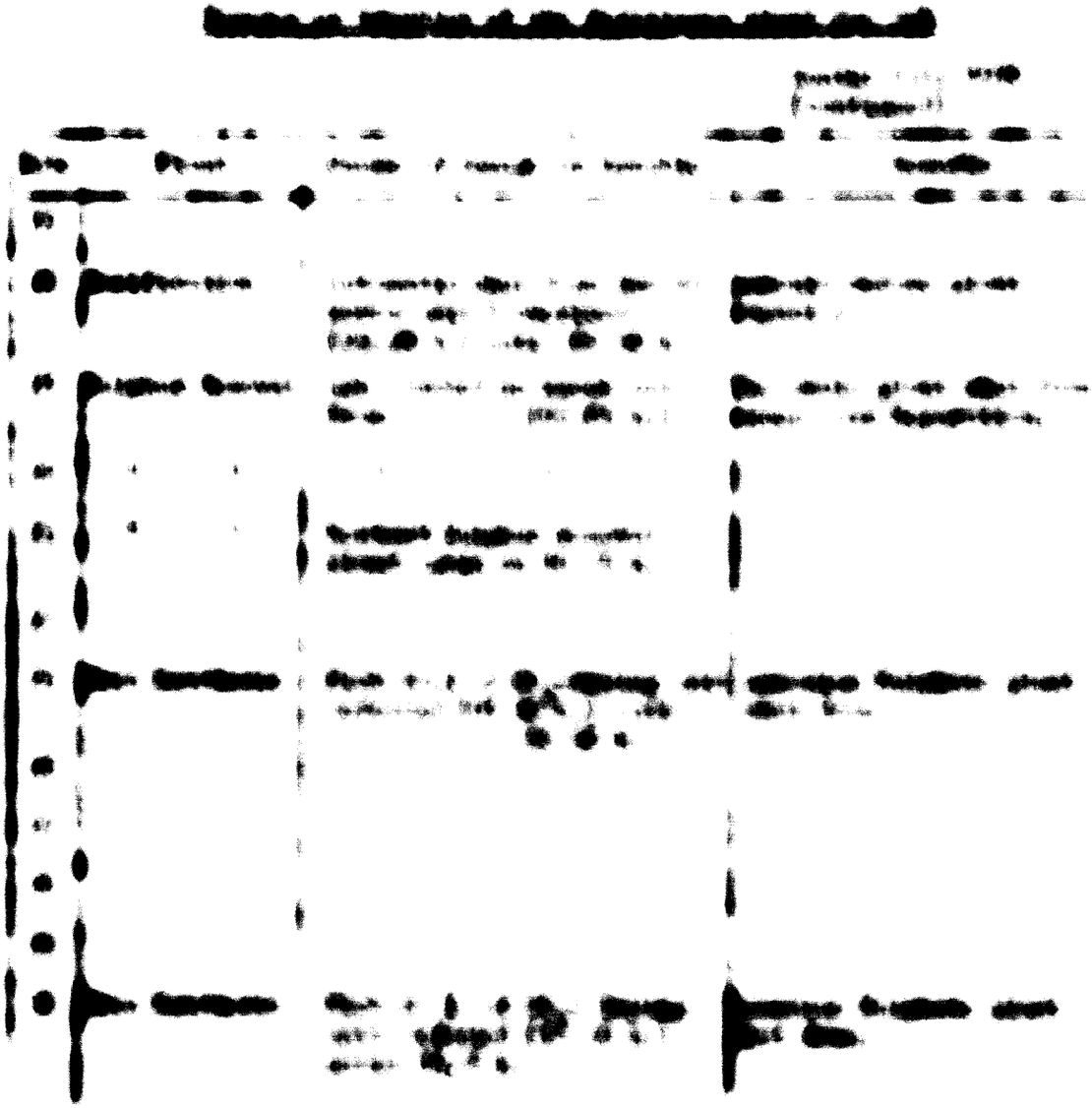
Date	Plant	Cause of damage or trouble	Remarks
19			
20			
21	Urea Synthesis	Liquid NH_3 not enough for operated. (12.30 h.)	Ammonium Sulphate plant shut down.
22	NH_3-Removal	Regulating of turbine defected. (1 .15 h.) until 17.15 h.	Ammonium Sulphate start by liquid NH_3.
23	Granulation	Automatic shut down due to screw unit 3 Overload (11.15 h.) Restart again on 13.30 h.	Ammonia reduced plant temporaily.
24			
25			13.30 h. Restart Urea Synthesis plant.
26			
27			
28			
29			
30			

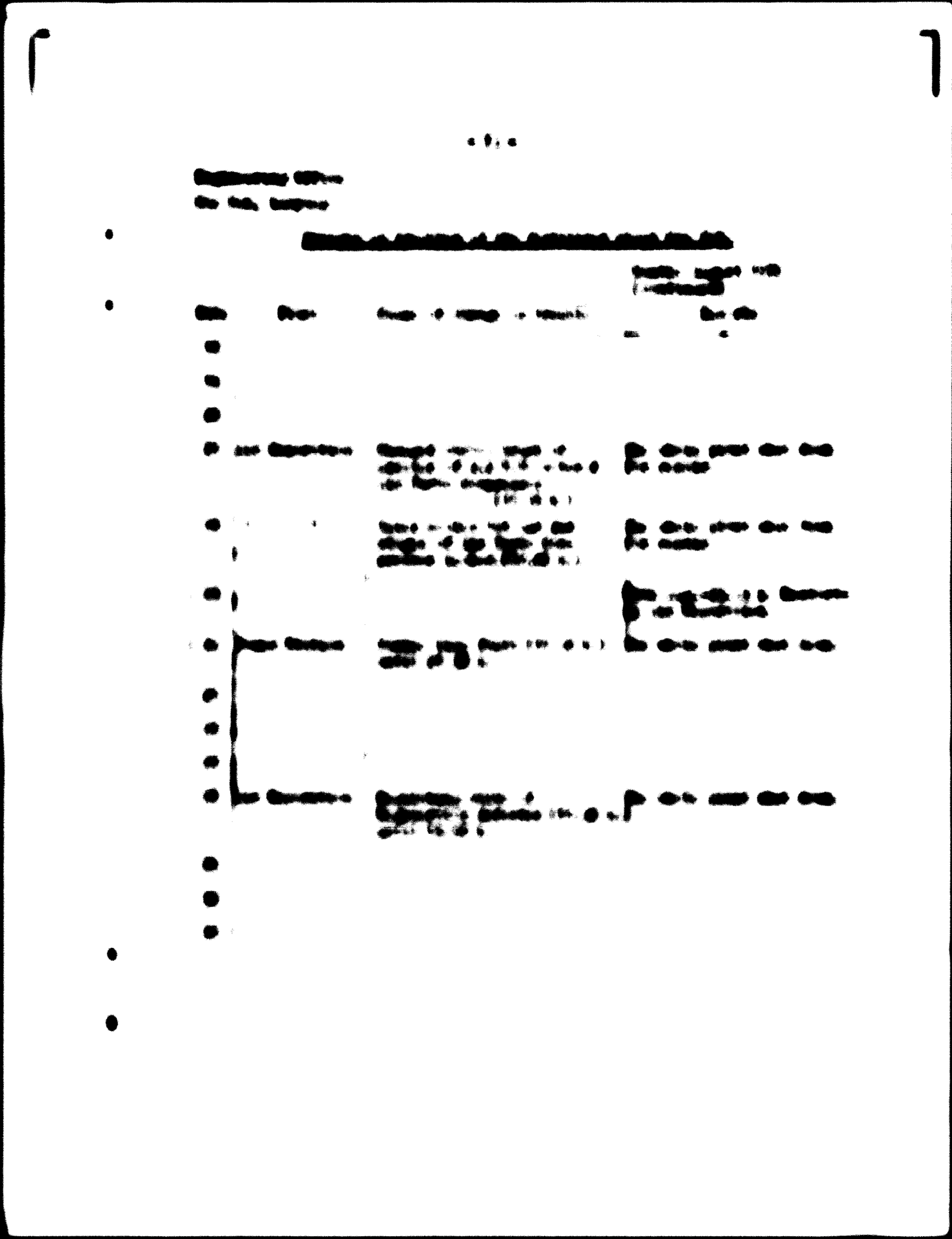
Engineering Office
Nam Kob, Lampang

Summary of troubles of the fertilizer plant Nam Kob

Month July 1970

Date	Plant	Cause of damage or trouble	Remark
1	Urea Synthesis	Liquid ammonia not enough for operation. (20.00 h.)	Ammonia fertilizer plant shut down.
2	Gasification	Ash extractor damaged. (60.00 h.)	The whole plant shut down except Air Separation.
3	Power Station	Turbine blade fault (17 ½ h. until 23.30 h. Restart of Air Separation plant.	The whole plant shut down.
4			
5			
6	Power Station	Turbine blade fault (03.30 h. until 07.00 h. Restart of Air Separation plant	The whole plant shut down.
7			
8	Gasification	Ash extractor damaged (11.30 h.) Restart again at 20.30 h.	Ammonia plant before operation. Restart the plant again at 08.15 h.
9			
10			
11			
12			
13	Catalyst Renewal	Ash blocked a Gasifier (10.30 h.)	The whole plant shut down except Air Separation and Ammonia plant.
14	" "	" " "	
15	" "	" (Restart again at 17.15 h.)	
16	Gasification	Slag blocked in Gasifier (20.00 h.)	
17	"	(Restart Gasification at 13.30 h.)	
18	Gasification	Temporarily shut down the plant (11.15 h.) until 12.45 h.	





Engineering Office
[illegible]

[illegible]

[illegible]: September 1970

Date	Plant	Cause of damage or trouble	Results
[illegible]			
[illegible]			
[illegible]	[illegible]	[illegible]	
[illegible]			
[illegible]			
[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]
[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			
[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]
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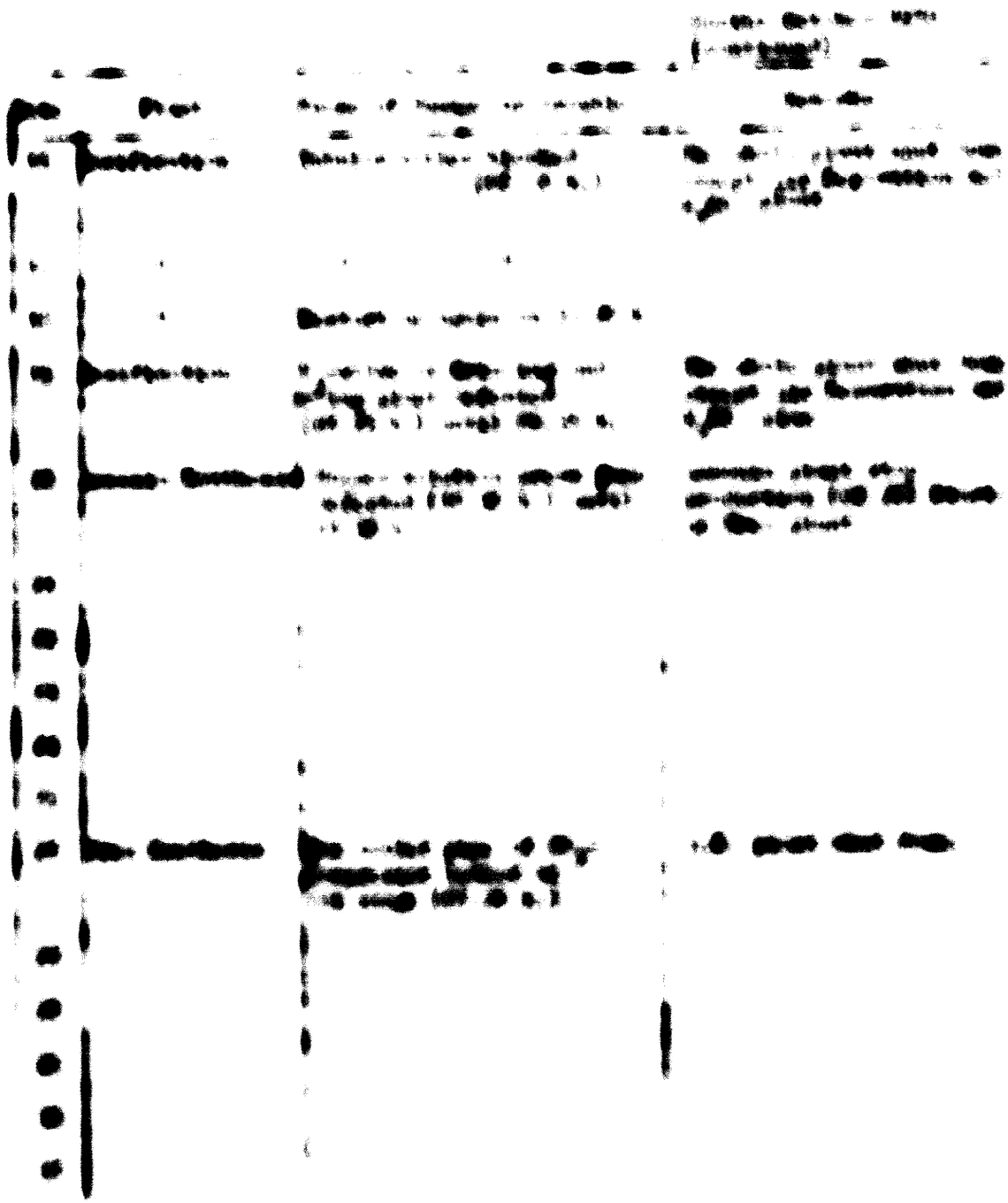

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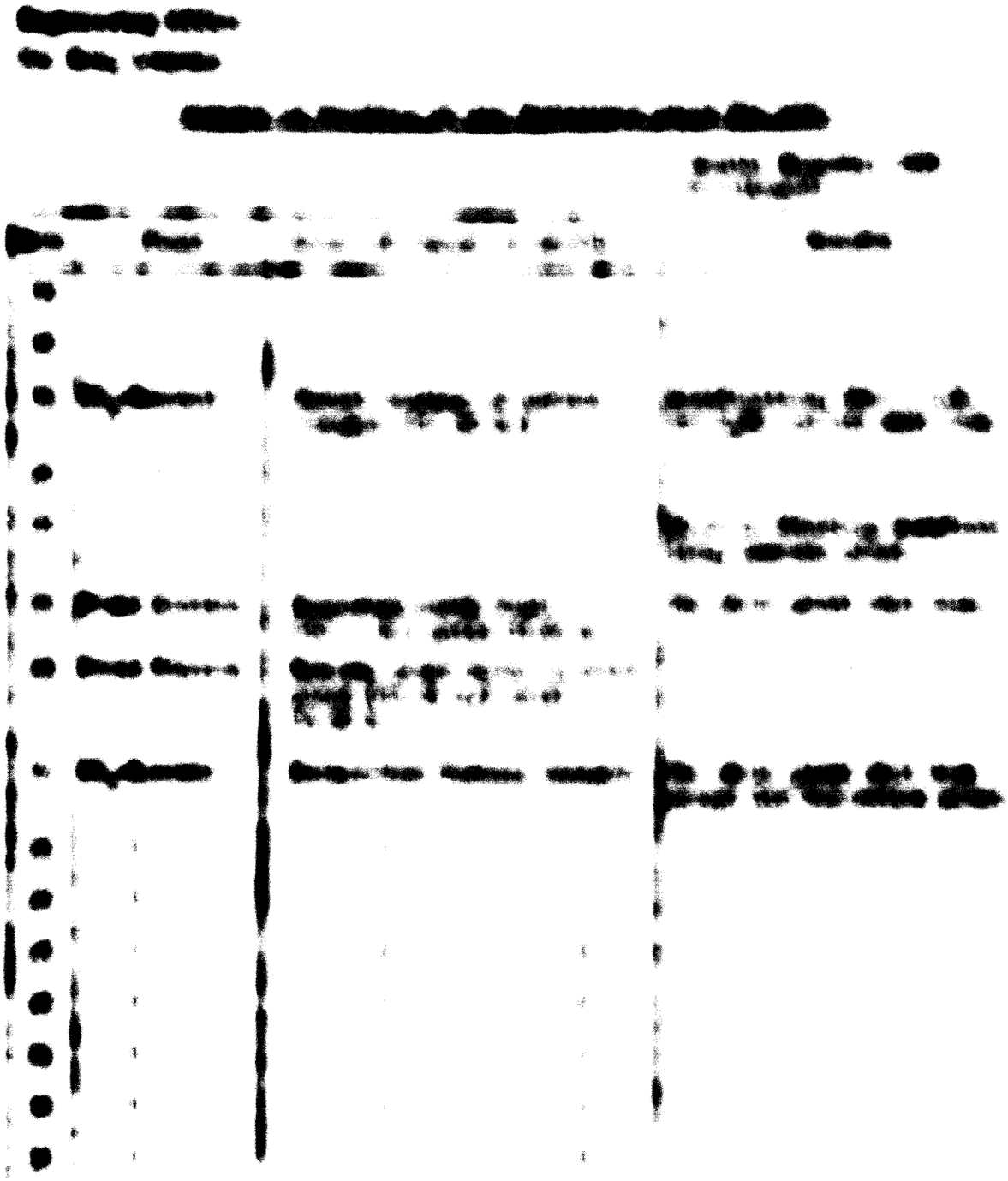

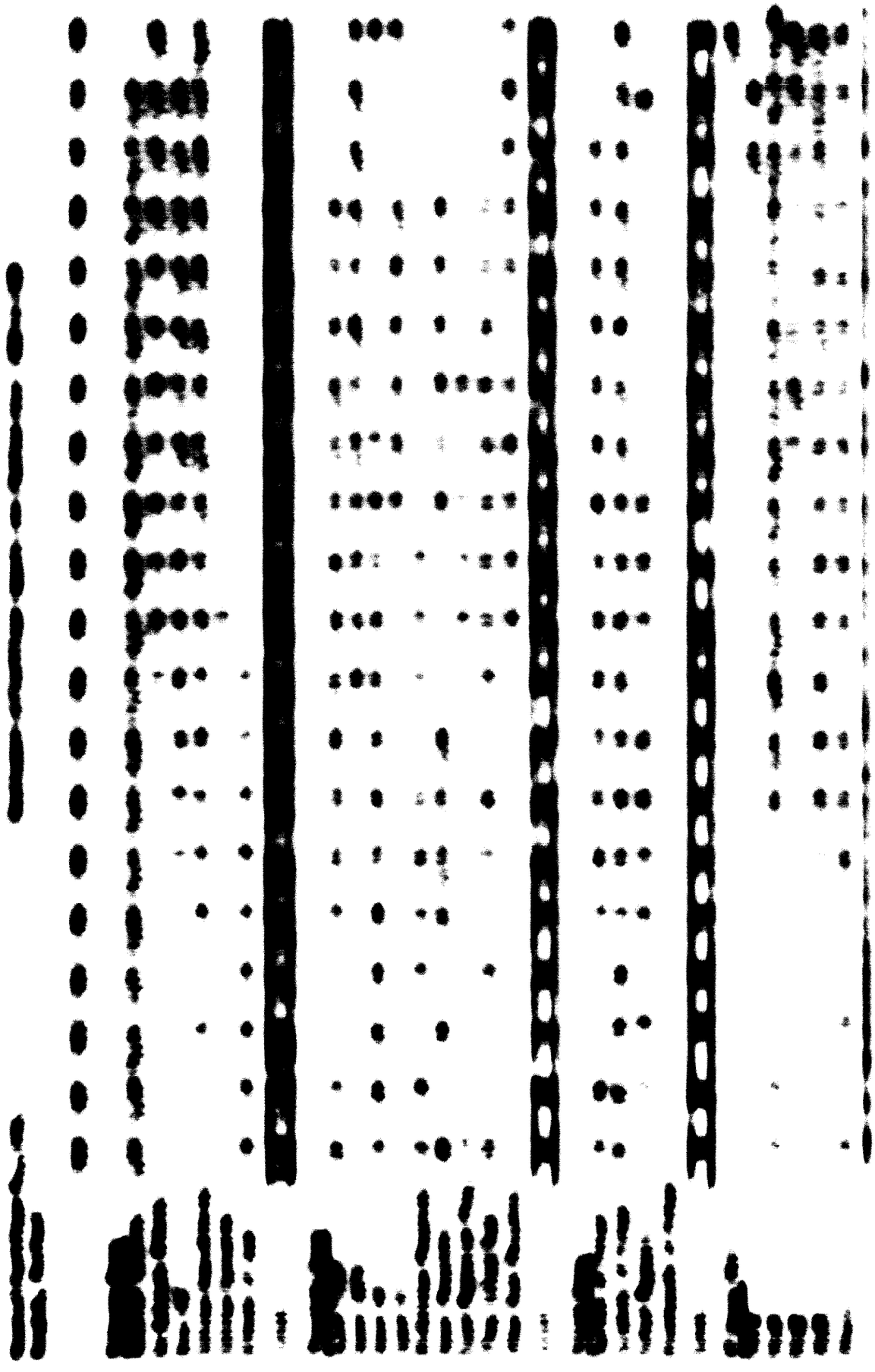

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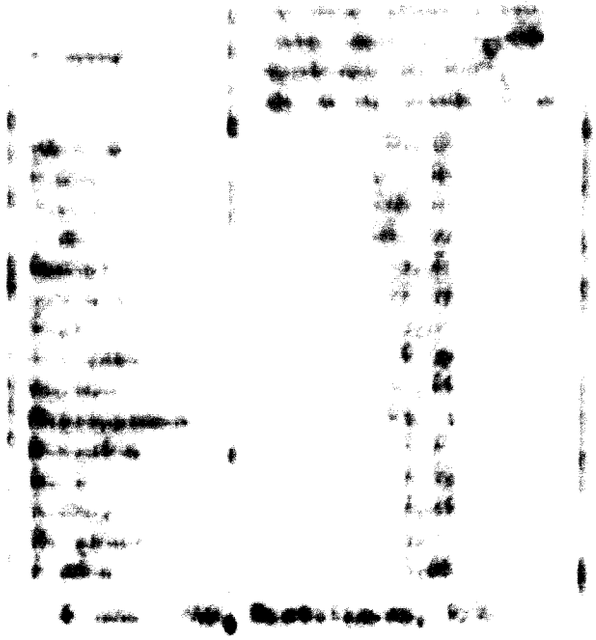

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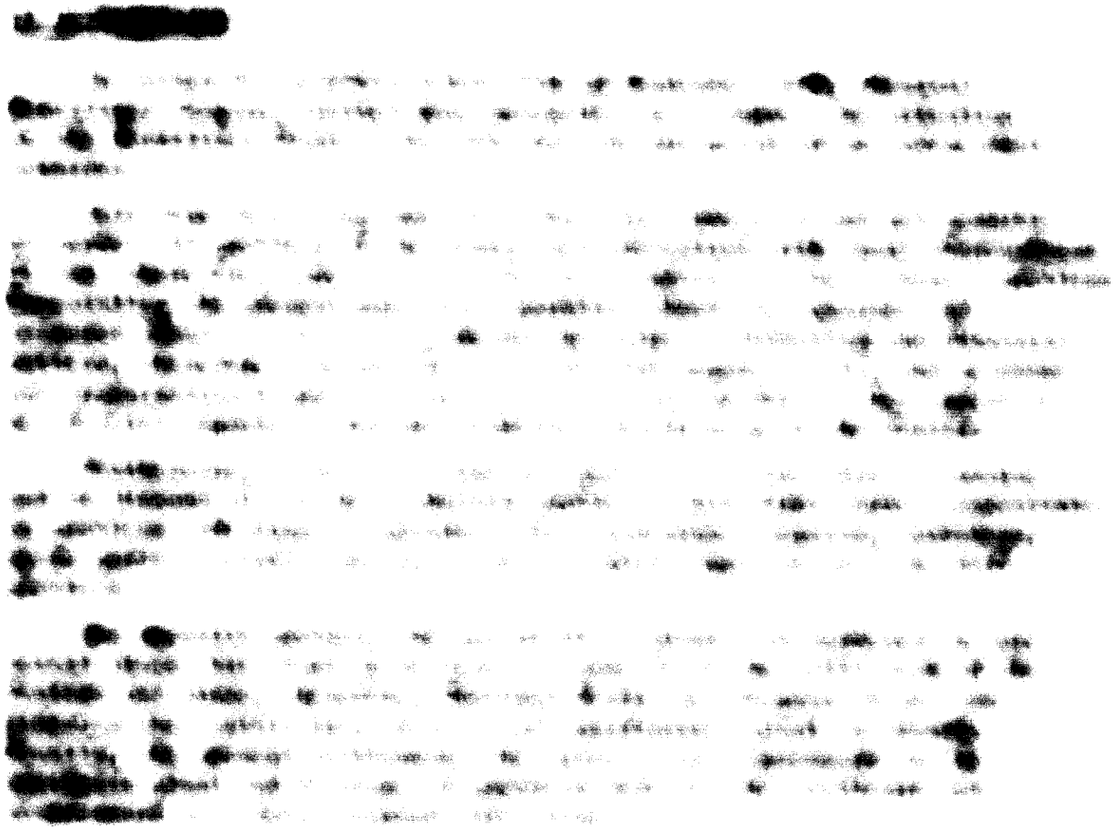

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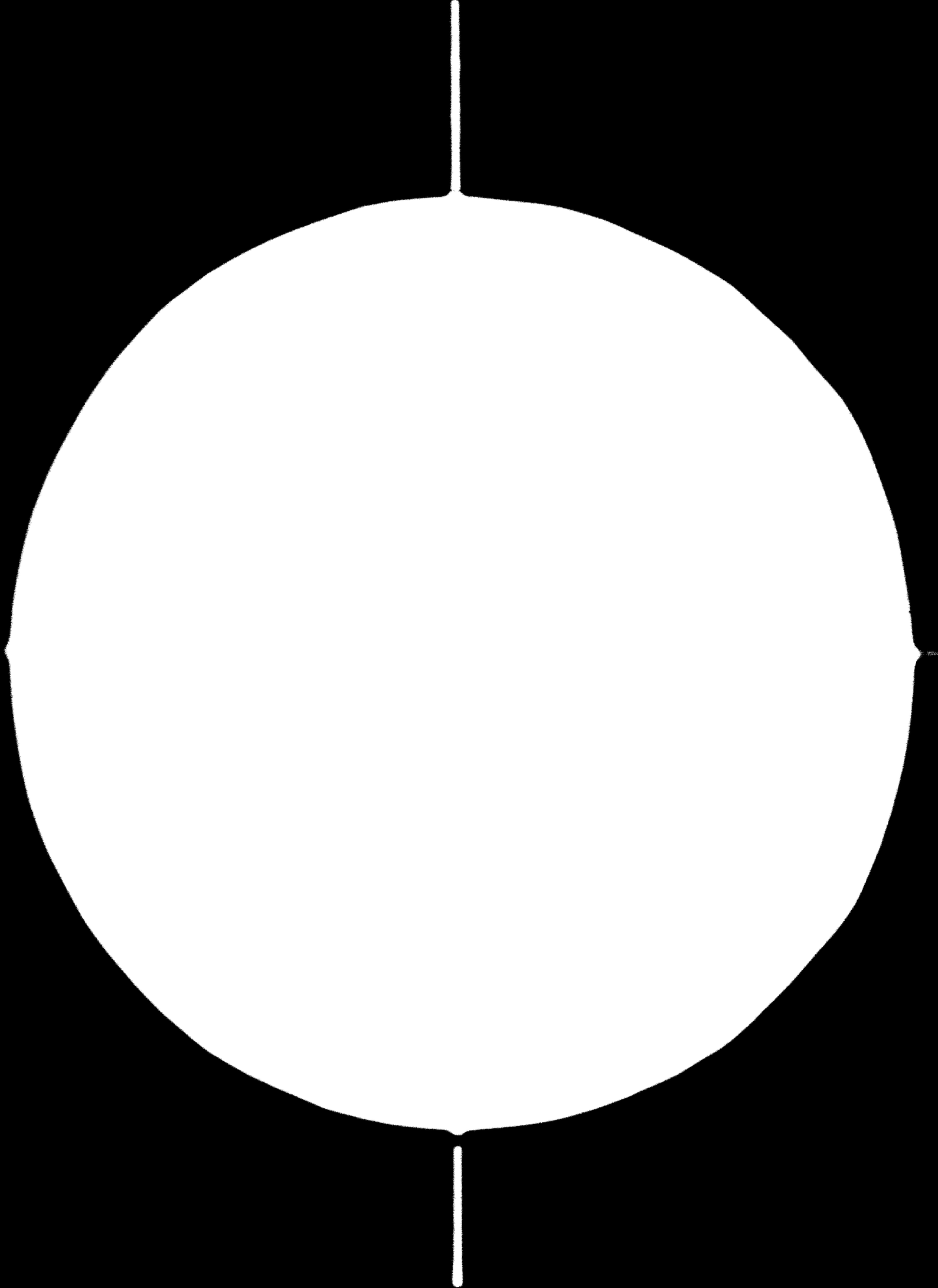

D) GENERAL PROBLEMS

1) Maintenance and Plant Problems.
A walk through the plants gives a first impression of their conditions, and shows the general problems. Mainly two kinds of problems come up:

a) Maintenance Problems:
Maintenance and repair cause considerable difficulties in the mechanical, measuring and control fields, to a lesser extent in the electrical field. Mechanical and measuring equipment is sometimes out of operation for a long time. On the electrical sector there are maintenance cards for each equipment item which show what kind of work has to be done at what time, and when it has actually been done. Such cards do not seem to exist for mechanical and measuring equipment items. See also chapters: Spare parts, and workshops.

b) Plant Problems:
This heading refers to difficulties which are caused by the specific design and construction of the different plants. In these cases it must be tried to correct, or to remove completely, any defects by modifying equipment concerned. This kind of work is especially difficult and requires a thorough understanding of the processes. If faults occur, for example high wear and tear because of dirt accumulation, it is not enough to repair the damaged parts. At the same time, a remedy must be found: f.i. it must be investigated whether and how the dirt accumulation can be reduced and thus further excessive wear and tear be avoided. As examples, refer to chapters Gasification Plant and Synthesis Gas Compressors. In this connexion, the simple case of a belt conveyor motor should be mentioned also which has to be cleaned every two days from the dust of the transported material, to secure the cooling of the motor. Sometimes also the ventilator of the motor is broken because of the dust. In this case, for example, a permanent remedy should be sought by moving the motor to another place or by covering the motor to protect it from dust, without, however, impeding the air circulation.

Before this survey was carried out, a list of faults of the plants found in the past has been given to us. Because of the short time available for this survey, and also because some of the faults occured a a long time ago, it was not possible to find the reasons for all of those faults. However, a short look through this list reveals that, besides unusual faults like breaking of the 2nd stage piston of the synthesis gas compressors, most of the defects have occured repeatedly. This shows that the faults have certainly been repaired every time, but that the reasons of the faults have not been removed, unless, of course, they were caused by normal wear and tear.

D.2) SPARE PARTS

Keeping of a sufficient stock of properly selected spare parts is vital for this kind of plant. Especially so because the average delivery time for parts now is 10 to 12 months ex factory abroad. One part missing may result in shutdown of plants for many months. For ordering spare parts a thorough knowledge of every machine (i.e. highly qualified personnel) is as necessary as definition of who is responsible for keeping a sufficient stock of parts for specific equipment items.

The total spare parts requirements should be checked again, not relying on the spare parts proposals of the suppliers only. The existing stock cards have to be completed - as far as necessary - by entering for each item a minimum stock quantity under due consideration of the expected requirements and of the long delivery times.

The spare parts may be classified according to their urgency, in the following manner:

a) Wearing parts: These are parts which wear out at normal operation, and which must be replaced at more or less regular intervals, or in between when repairs are carried out, such as for example: sealings, stuffing boxes, piston rings, bearings, valve plates, breaker contacts, fuses, lamps, etc.

b) Essential components and accessories normally not subject to special wear during operation, but which, when defective, cause a shutdown of a plant, and which cannot - or only under great difficulties - be repaired. Some of these essential components are: special analysis equipment, measuring equipment, control equipment, oil pumps for compressors, piltons, piston rods, plungers, etc..

c) Equipment which can normally be repaired locally; for example: coolers, heat exchangers, motors, etc.

d) Catalysts which have to be replaced or replenished after a certain period of operation.

It is recommended to check the stock position of all parts in following order:

1) All those wearing parts, and all those essential components, which, when becoming defective, may necessitate a plant shutdown or an operation at partial load. (If the air turbo compressor or the CO_2 compressor fails, the entire plant must be stopped, or when one of the synthesis gas compressors or of the circulating compressors fails, the plant will operate at reduced load.)

2) All wearing parts of those machines for which a stand-by unit is available and which would not cause a shutdown of plant if one unit breaks down. This would include nearly all process pumps and blowers.

3) All other spare parts

The present half load operation of the synthesis plant is due to the missing of the stuffing boxes for the circulating compressors and shows the importance of spare parts plannings. These stuffing boxes for the compressors working at 450 atm are wearing parts constituting a danger point in the synthesis plant and should be in stock in a sufficient quantity.

It was not possible in the short time of this survey to make a thorough check of the spare part store, and to make specific proposals for certain items. It could be seen in the spare part store that, generally, a good stock is kept. But on the other hand, a quick check of the stock cards for the synthesis gas compressor parts, as an example, showed that only one set of stuffing boxes for the 1st, 2nd and 3rd stage are available although two compressors are in operation. Since this is a wearing part with a long delivery time it is not sufficient. Yet, there is a good supply of 1st stage coolers in the store, which cannot be

considered wearing parts. Here, the necessity for controlling the spare parts stock in the above mentioned manner can clearly be seen.

D.3) WORKSHOPS

For carrying out fastand efficient repairs, well equipped workshops are necessary. The mechanical workshop is equipped with good machines, but, in addition, a bigger lathe or a big boring mill is necessary. Furthermore a balancing machine for the high speed pump and blower impellers would be useful. The workshop for repair of measuring and control equipments is only very moderately equipped and has to be improved. A detailed survey was not possible due to the limited time. Also, the planned survey of the laboratory had to be cancelled.

E) SPECIFIC PROBLEMS

E.1) ELECTRIC POWER SUPPLY

One of the reasons listed for frequent plant shutdowns are line faults and power plant failures, sometimes for long periods of time. Therefore, the electric power supply system was surveyed. The fertilizer plant is supplied through two 11 KV/6KV transformers of 8 MVA each by the power plant in Mae Moh, and by a 69 KV high tension line from the Yanhee Dam through the substation and the 69 KV/11KV transformer of the Mae Moh power plant.

The consumption of the fertilizer plant is about 8MW at half load and about 11 MW at full load. The power plant, with two turbines of 6.25 MW each designed for 12.5 MW, generates not more than 8-9 MW for reasons which have not been surveyed. Furthermore, the power plant supplies 4 to 5 to/h of steam to fertilizer plant, which is equivalent to 0.8 MW to 1 MW of electric power. That means that during a shutdown of the Yanhee high tension line, the power plant is not in the position to supply the power required for full load, and then allows only half load operation. If one turbine is shut down i.e. only 4 to 4.5 MW are available, most of the plant sections have to stop operation, too. But since a failure of the power plant and of the high tension line will hardly occur at the same time for a longer period, the power supply seems not to be a serious problem in principle.

The difficulties rather arise when starting the big 6KV compressor motors, by the short but high peak load which causes a considerable voltage drop and the release of the undervoltage relays. Experience shows now that the 2.5 MW compressor motors may be started only if the power supply of the high tension line is available, and when, in addition, at least one turbine of the power plant is working. Neither the high tension line alone, nor the two turbines of the power plant alone, supply sufficient power for starting the compressor motors. This is the reason for repeated shutdowns of the plant for several days, and it shows the necessity to improve the starting conditions for the 2.5 MW motors, particularly because a general improvement of the power supply situation can be expected only when the 115KV high tension line from Sirikit Dam is completed in a few years time, and when the plant is connected to that line.

There seems to be possibilities for short-term improvement, and the following proposals are made for different conditions of operation.

a) Start by two turbines of the power plant during line fault of the high tension line:
Experience has shown that starting the 2.2 MW motor for the air turbo compressor is still possible under these conditions, while the higher consumption of the 2.5 MW motor causes a switch off because of undervoltage. Therefore, it can be assumed that relatively little voltage increase at the time of starting would be sufficient to put also the 2.5 MW motors in operation. The generating voltage of the power plant is normally 6.4 KV and can be increased to 6.8 KV. Furthermore, the voltage regulating transformer in the power plant can be set from 11KV to 13.3KV at these voltages, starting of the motors and operation of the factory at 50% to 60% capacity should be possible even during shutdown of the high tension line.

b) Start by the high tension line during shutdown of both turbines of the power plant (in this case one boiler of the power plant must still be operated to provide the steam required for the factory):
In this case the Yanhee Power Plant should be notified before starting the motor, and should be requested to increase the voltage to the highest level permissible in the power plant, for the starting period. A 10% increase from 69KV to 76KV should be possible. The exact possibilities could not be clarified in the Mae Moh Power Plant and have to be discussed with the Yanhee Power Plant.

c) The voltage characteristics during starting the motor after a voltage increase according to a) and b) have to be examined by trials. Possibly, resetting of the undervoltage relays and setting for delayed response is possible.

If the above mentioned measures should not be successful, a starting reactor can be installed for the big motors. EGAT is also planning the installation of voltage stabilizing capacitors. This project should be sped up.

E.2) STEAM SYSTEMS

Three steam systems with 29 atm, 11 atm and 4.5 atm respectively are used in the factory. Most of the steam required by the factory is produced in the different plants of the factory itself. The additional steam of about 4 to 5 to/h with a temperature of 450°C and a pressure of 46 atm is supplied by the power plant and later reduced to the needed pressure and temperature.

This means that at least one of the two power plant boilers must run for the operation of the fertiliser plant. By having an own boiler, the fertiliser plant could operate at full load using the Yanhee high tension line, during shutdowns of the Mae Moh Plant. Therefore, Chemferco is planning to install an own boiler with 30 atm and 10 to/h steam output. When no steam must be supplied by the power plant, it would be in a position to increase the electrical power output to 10 MW and to improve thereby the power supply of the Fertiliser Plant. The assumed capacity of the boiler of 10 to per hour is on the safe side and also allows operation of the different plants, even when other plants normally producing steam are shut down, like the sulphuric acid plant and the gasification plant.

E.3) COOLING SYSTEM

The cooling water system is also very important since the quality of the water and the availability of a sufficient quantity influences directly the capacity of all plants, and also the lifetime and maintenance intervals of the coolers. Dirty water promptly causes a reduction of the capacity and prohibits full load operation. The cleaning of the coolers is a time consuming job which necessitates stopping the plant, and thus an interruption of production. Chemicals in the water may cause corrosion of the cooling tubes and thus a shutdown of the cooler. This is normally repaired by blocking the damaged tubes which effects a reduction of the cooling capacity. About 20% of the cooling tubes were found blocked in some coolers. Insufficient availability of cooling water has the same effect. At the moment 3000 cbm/h of cooling water is taken from a reservoir and, after passing through the factory, is returned through a long channel. This is the simplest way, but it does not allow to take any influence on the quality and quantity of the water. To secure, to a certain extent, availability of the required quantity of water independently from seasonal variations, the reservoir has been deepened after water shortages have been experienced in the past. It is still not possible to take an influence on the quality of the water with regard to mechanical and chemical purity.

It is therefore proposed to use a circulating cooling system with cooling towers. In this case only the losses of water and the water used in the process have to be taken from the reservoir. This quantity is small in comparison with the total of cooling water needed and can therefore be cleaned economically in a water treatment plant. The circulating water can be controlled continuously by adding anticorrosive chemicals.

E.4) GASIFICATION PLANT

It has been claimed by some that the gas production is the bottleneck of the plant. This impression came up because a fault in this plant influences directly all the other plants. Since the installation of a second gasifier is under discussion, the problems of the gasification plant have been surveyed more closely. It is believed that in a new gasifier of the same type the same deficiencies may occur, and that the investment for a second gasifier is not justified. Instead of this investment, funds should be made available to improve the existing plant and to carry out other measures recommended in this report.

The present situation in the gasification plant is this:
The lignite preparation in the mill is working without major difficulties. The stock of prepared lignite in the lignite storage provides for a 12-hour operation of the gasifier and gives, therefore, sufficient time to repair this section in case of faults. The nitrogen and oxygen supply as well as the transportation of the lignite dust gives no trouble. The fault in the electric filter can be repaired; this, however, does not influence the gas production. Defects of the level control in the lignite service bins as well as of the temperature measuring equipment of the gasifier and of the CO_2 and O_2 analysis equipment, are merely maintenance problems. These equipment items have to be repaired or replaced. The frequent automatic shutdown of the plant by one of the four lignite feeders supposed to be due to overload was actually caused by a too low setting of an overload relay which could be adjusted.

Furthermore, the blocking system could be modified so that the plant is not stopped by shutdown of one lignite feeder. Operation with three feeders working is still possible.

A real problem seems to be the slag removal. The slag is removed in a fluid state. This requires maintaining the temperature well above the fluid point of the ash of about 1300°C. Since, however, as above mentioned, the temperature measuring is not functioning, and the continuous CO_2 analysis equipment which also allows the calculation of the temperature is not in operation either, the operators rely on their guessing and upon the hourly manual CO_2 analysis made by the laboratory. But this is not sufficient for a continuous process control especially in case of part load operation. The personnel is maintaining a too low temperature for safety reasons. It is assumed that by maintaining the proper temperature, the problem of slag removal may almost completely disappear.

A more serious problem is the ash deposits in tubular boiler which require cleaning the boiler after every month of full load operation. The cleaning requires a shutdown of the plant for about 48 hours. For blowing out the ash, the supplier of the plant has provided a steam nozzle. But this does not seem to operate. Whether this is due to the relatively low 11 atm pressure of the steam used, and whether a higher steam pressure of about 30 atm would show better results, would have to be found out by trials. Anyhow, the following proposal would certainly give the results wanted: A new pair of flanges should be installed between the connexion of the radiation boiler and tubular boiler to provide a possibility for inserting a blind plate. For blowing out, a blind plate should be installed between these flanges. By this the tubular boiler would be separated from the radiation boiler. Now, the steam of 11 atm used for blowing out cannot escape into the radiation boiler and is therefore forced to pass through the tubular boiler at high speed, blowing out the ash. This work can be done in about one hour so that a shutdown of the synthesis plant would not be necessary, the gas storage of 6000 Nm^3 being adequate for operation of the synthesis plant at half load for one hour.

The most serious problem of the gasification plant is the washing tower. The water for washing the ash out of the gas is recirculated through a settling reservoir. But the settling of the ash components is not sufficient so that the particles still contained in the water close the tubes and the nozzles after a short time. This makes the washing process ineffective. The cleaning of the tubes is very difficult and often not possible so that after a certain time new tubes have to be installed. The first measure is to make an exact analysis of the deposits. After that it can be decided whether the particles can be removed by a filter plant or whether chemical treatment in a new settling reservoir is necessary. The last solution seems to be more suitable. This plant must have a capacity of about 200 cbm per hour.

Good washing is very important since high ash content endangers the subsequent Theisen washers and gas blowers, as well as the sulphur removal plant. Ash deposits on the blower impellers have caused a shutdown of the plant in the past. Cleaning of the impellers is difficult and unbalance of the impellers due to the deposits causes trouble. Ash deposits in the sulphur removal plant have also seriously affected the operation.

The above explanation of the existing faults shows that the same trouble will also occur in a second plant of this type, and that instead of installing a new plant the defects of the old plant should be required. For the critical components of the plant as pumps and blowers, stand-by units are provided anyway.

E.5) SYNTHESIS GAS COMPRESSORS

a) In 1968 the 2nd stage pistons of both synthesis gas compressors were broken. This is an unusual fault and the reason cannot be clarified exactly anymore. An examination of the operating data shows that at the time of breaking the compressors were working under normal operating conditions. However, the damage might have been caused by wrong operation in the time before. For the balance of mechanical forces a certain pressure ratio between the specific stages of the compressor has to be maintained. For this reason clearance pockets have been provided which have to be opened by the operating personnel if the pressure ratio is changing to a certain extent, especially at part load operation. The clearance pocket of the 2nd stage has to be opened if the discharge pressure of the first stage drops below 2.1 atm. The clearance pocket of the 3rd stage has to be opened if the discharge pressure of the 2nd stage drops below 8.6 atm. If these clearance pockets are not opened under the above mentioned conditions, damages like the fracture of pistons or piston rods may happen.

b) The short circuit of the windings of one of the two 2.5 MW/6KV compressor motors is due to the high humidity absorption during stand-still over a long time. Since operators now know the danger of this high humidity content in 6 KV high tension equipment and since therefore the necessary drying is carried out before starting this fault will not occur anymore.

c) The breaking of valve plates is not unusual for compressors working under similar conditions. This damage is often caused by dirt accumulation in the gas. Scores on the valve seats inspected show the effects of dirt. The dirt in the gas also causes high wear of the stuffing boxes and piston rings. Therefore, the particles in the gas should be analysed to find out their origin and to possibly eliminate the trouble source.

d) Some coolers showed heavy corrosion of the radiator fins of the cooling tubes on the gas side. This points to acid vapors in the gas. An analysis of the corroded parts should give the exact reasons for the corrosion and lead to its elimination. While dirt on the water side is not unusual and the straight tubes on the water side can be cleaned mechanically, the radiator fins on the gas side do not allow such method of cleaning . Because of the fins, individual tubes cannot be replaced. A complete cooler, therefore, has to be installed if blocking of cooling tubes is not more possible. The corrosion products in gas stream endanger also the compressor valves etc. (see also c) above).

F) CAPACITY SURVEY OF THE PLANTS

At the time of this survey the fertiliser factory is working at 60% capacity. Obvious reason for this part load operation is the shutdown

of a circulating compressor in the synthesis plant, due to stuffing box damage. A spare set of stuffing boxes is not in stock so that the compressor cannot be repaired. The arrival of the stuffing boxes is expected any day.

Due to the missing stuffing boxes, full load operation was not possible and it was therefore also not possible to find out all bottlenecks of the factory.

The gasification plant seems not to be the only weak point. It is uncertain whether other plants now working satisfactorily at half load can operate at full load. Experience with such plants shows that half load operation is relatively easy, and that difficulties occur more often when endeavours are made to reach full load output. Difficulties usually occur in gas cleaning plants, for example sulphur removal plant, CO_2-removal plant, final purification plant, and in synthesis plant or CO-conversion plant. Therefore it is suggested to carry out (after repairing all known defects and after checking all measuring and control equipment) a full load trial of every plant and to find out the real working capacity as well as concealed defects. These trials have to be made with great care and all pressures, temperatures and analysis have to be permanently observed. The capacity of each plant should be individually tested one by one, to secure the availability of all maintenance and repair people for immediate action if necessary.

This capacity test should be repeated periodically after some time of partial load operation to be sure that the full operating capacity has not been reduced by causes like dirt accumulation in coolers and heat exchangers, reduction of activity of catalysts etc. During standstill of one plant, which may be caused by other plants, defects previously found in that plant can be repaired in a prepaired and organized way.

The following plants can undergo those full load trials:

a) Urea plant together with ammonium sulphate plant and CO_2 desulphurisation plant. First the ammonium tank, sulphuric acid tank and CO_2 gashold have to be filled up by partial load operation. Then a three-day full load trial is possible.

b) Sulphuric acid plant: After emptying the acid storage tank, full load operation for about two days is possible.

c) Gasification plant and sulphur removal plant can be operated at full load for any period of time, by burning off the gas.

d) Likewise, the air separation plant can be operated easily at full load by blowing off the gas.

e) The synthesis plant can undergo full load trials for only up to one hour as long as the gasification plant is operating with partial load only. This time is sufficient to give essential information on the working capacity of CO-conversion, CO_2-removal, final purification and synthesis.

Trials as above suggested, besides permitting localisation of defects, also give a good opportunity for training the staff. The necessity of such full load trials can be seen at the sulphuric acid plant as an example. The plant was producing without difficulties about 70 to 80 tons per day for the half load operation of the factory. When the production was to be increased to the maximum capacity of about 150 tons per day, for selling sulphuric acid outside the plant, it was found that the output

could be increased to 100 tons per day only.

In this connexion it should be mentioned that also sales of O_2, N_2 and CO_2 may be an additional source of income because there is a market for those gases.

G) CONCLUSIONS AND PROPOSALS

This report shows that the difficulties of the fertiliser plant result from technical problems as well as - to a greater extent - from maintenance problems, that is staff problems.

To effect an improvement of the whole situation as soon as possible, the following short-term, medium-term and long-term measures are proposed:

1) Short-term measures (to be completed in about three months):

   a) Review of spare parts stock and procuring of parts for all plants, according to the priority steps as specified.

   b) Thorough checking of the existing workshops and laboratories, for availability of equipment needed.

   c) Localising and repairing defects in all plants.

   d) Full load trials of one plant each at a time, to find out and to repair concealed defects.

   e) Negotiations with EGAT with a view to increase the voltage so as to improve the starting conditions of the big compressor motors.

   f) Ordering of an own steam boiler.

2) Medium-term measures (to be completed within six months):

   a) Planning and carrying-out of the proposed modifications of the gasification plant.

   b) Planning of personnel requirements with regard to both number and qualifications, and establishment of training programmes.

3) Long-term measures (to be completed within 18 months)

   a) Installation and start-up of the new boiler.

   b) Possibly, construction of a circulating cooling system with cooling towers.

   c) Preparing for connecting the factory to the planned 115 KV high tension line, and ordering the required transformers, switchgears, cable, etc.

Annex 22

APPLIED SCIENTIFIC RESEARCH CORPORATION OF THAILAND

CONTACT NOTE NO. 16/19

Subject: Fertilizer industry

Contact: Mr. Somnuk Pradithsvanij, Acting Mill Manager
Chemical Fertilizer Plant, Mae Moh, Lampang

Contacted by: Mr. M.C. Verghese, Chief
Fertilizers, Pesticides and Petrochemicals
Industries Section, UNIDO
Mr. N. Ramm-Ericson, Field Adviser, UNIDO
Dr. C. Chu, UNIDO Adviser

Date: 14 - 15 March 1971

Place: Mae Moh, Lampang

Remarks:

This was my second visit to the plant after my first hasty visit on 3 - 4 February 1971. Mr. Ramm-Ericson of UNIDO took quick action and brought Mr. Verghese to Thailand when Mr. Verghese was touring this area for inspection of fertilizer industry.

This visit was focused on the operating problems of this plant. A panel discussion with all key operating personnel was held on Sunday evening , 14 March, after we completed a tour of the plant. Candid opinions were heard from all section chiefs of the plant in regard to difficulties encountered in operations and maintenance, and their suggestions for improvement.

On the following Monday morning, we made further visits to the plant to see the water treatment area, chemical laboratory and workshop, and some damaged parts of compressor were examined.

Upon return to Bangkok, our findings were reported verbally to Mr. Kraisri, Managing Director of Chemical Fertilizer Co. and ASRCT officials during lunch on Tuesday, 16 March 1971. At 2.30 p.m. the same day, further discussion was made with Mr. Friess, Manager of Engineering Department of B. Grimm Co., Bangkok, for exchange of views with Mr. Verghese. The Grimm Co. was the agent of imported equipment for the plant. We expect that their co-operation and assistance will be needed.

Mr. Verghese, with his experience in lignite fertiliser production in India, has made many suggestions for improvement of the plant operations. We may draw the following conclusions from all sources of information in regard to further actions to be taken to expedite the improvement work for the plant:

1. The gasifier in the Chemical Fertilizer Plant needs better temperature control with thermocouples and/or pyrometer. Recording temperature control would be more desirable. The present practice of CO_2 analysis on hourly basis to correlate and estimate operating temperature is inadequate.

2. The gasifier operation is very dangerous without adequate brick lining. Lack of blueprint of the gasifier and no instruction manual for operation and maintenance work are reported by the operating staff in this section. Mr. Friess of B. Grimm Co. is also aware of this lack of lining and poor maintenance work. The gasifier was supplied by Koppers Co. through B. Grimm Co. The impending visit of an engineer from Koppers Co. to Bangkok may help to solve this problem. A thorough inspection of the gasifier and overhaul of the brick lining will be called for. The Chemical Fertilizer Co. should request B. Grimm Co. to contact all relevant manufacturers of equipment which supplied the machinery to the plant for at least three copies of blueprints, operation manuals and instruction manuals for maintenance.. One copy should be kept at the head office, one for plant manager and one for chiefs of operating sections.

3. Coherent maintenance work is needed to make all units work together. Adequate storage capacity for intermediate products such as sulfuric acid tank should be added to reduce down-time of ammonium sulfate plant. UNIDO may provide two to three experts for short-term assistance on operation of the gasifier, plant maintenance and instrumentation. Also training fellowships could be arranged for the key personnel of the plant to receive training in a lignite fertiliser plant in India, which produces about 300 t/d of ammonia. Advanced training abroad also will boost the morale of the staff. The manpower problem of this plant is quite serious and more incentive and fringe benefits are needed to attract good men and keep them.

4. Inadequate water treatment in the plant has caused many breakdowns and corrosion of equipment. The cooling water for gas scrubber should be treated. Not all condensates from various equipment are returned to the boiler. The present production of steam exceeds the capacity of the water softening plant at 20 t/h. Overload of the water softening plant has reduced the quality of feedwater for boilers. The plant is buying steam of 45 kg/cm^2 at 3 t/h from the thermo-electric power plant. The water treatment plant is operating at about 100 m^3/h whereas water intake for the whole plant has three pumps at 1600 m^3/h each. Usually two pumps are in operation to supply water at about 3,200 m^3/h. Thus the water treatment plant is far from adequate to meet the need of the plant. To reduce the expense of water treatment, a closed water system can be installed with water cooling pond, complete condensate return system and special water treatment facility to prevent corrosion. With the assistance of a specialist in water engineering, TRI may provide some help to the plant for proper use of water in processing. Perhaps the Asian Institute of Technology may be requested to co-operate with ASRCT on the question of water treatment at the Mae Moh plant.

5. Mr. Verghese has indicated that UNIDO is planning a fertiliser conference in India in November 1971. The Chemical Fertiliser Co. will be invited to participate in this international meeting. Field trips will be provided for all delegates to visit fertiliser plants in India including the lignite fertiliser plant. Delegates from the Chemical Fertiliser Co. will have the opportunity to meet international experts and make plant visits for exchange of ideas on plant management.

ANNEX 81 - 10[illegible] -

[redacted]

[redacted]

Post titles	Lignite-oxygen gasification expert (fertiliser plant)
Duration	Eight months
Date required	As soon as possible Possibly before September 1971
Duty stations	Mae Moh, Chemical Fertiliser Plant, Lampang, Thailand with travel in Thailand as necessary
Duties	The expert will be assigned to the fertiliser plant at Mae Moh and will be expected to:

1. Review the technical difficulties experienced by the lignite gasification plant, especially the Koppers gasifier using the oxygen gasification process;
2. Suggest remedies and assist in solving the technical problems in order to bring the gasification plant to sustained higher capacity production and reaching designed capacity;
3. Particularly study and solve lignite-feed problems, problems connected with ash fusion temperature, optimizing of the gasifier, fouling of boiler tubes and blower impellers with dust, instrument troubles and analytical procedures, purification and settling problems of water used, quality of lignite used, etc.;
4. Establish minimum spares required for continuous operation and assist in procurement or fabrication of vital spares;
5. Assist in procuring operation manuals, blue prints and detailed specifications and drawings of equipment and machinery and bringing them up-to-date;
6. Train local staff in the support, safe and sustained operation of the plant;
7. Assist in any other manner to help the whole fertiliser complex to obtain full designed capacity;
8. Act as leader of the Argentine team of experts and keep close liaison (including making monthly reports) with local management and management of headquarters in Bangkok, TDI (Technical Development Institute in Bangkok) and UNIDO in Vienna.

chemical technology or

Qualifications: Advanced degree in/engineering. Extensive experience in design, construction and operation and trouble-shooting in fertiliser plants. Especially experience in oxygen gasification of lignite using Koppers, Winkler, Lurgi and other processes. Experience in developing countries will be an advantage.

Language: English

Background information: The only nitrogen fertiliser plant of the country is situated at Mae Moh, Lampang, Northern Province. It is designed to produce per year 26,000 tons of nitrogen (in end products) based on 330 working days using lignite as raw material to produce ammonia. The designed capacities are as follows (tons/year): -

Ammonia	33,000	
Urea	28,000	
Sulphuric acid	48,000	
Ammonium sulphate	63,700	(all in round figures)

Although the production was started in 1967, the full year of operation was only attained in 1970. Even in this year only 41% of designed capacity was reached in the ammonia plant. The technical troubles were mainly connected with the lignite gasifier using Koppers oxygen gasification process.

The Chemical Fertiliser Co. Ltd. (CHEMFERCO) which owns and operates the plant (majority owned by Thai Government) has requested UNIDO assistance through the TRI for a team of experts to help solve the technical problems and bring the plant up to designed capacity production. Thailand presently imports about US $ 25 million worth of fertilisers. Hence, the importance of increasing local production is evident and the Government gives top priority to the request.

Request from the Government of Thailand

Draft Job Description

Post title: Mechanical engineer - fertiliser plant maintenance

Duration: Eight months

Date required: As soon as possible
Possibly before September 1971

Duty station: Mae Moh, Chemical Fertiliser Plant, Lampang, Thailand

Duties: The expert will be a member of a three-man team working under a team leader and will be assigned to the chemical fertiliser plant at Mae Moh and will be expected to:

1. Review the mechanical maintenance problems facing the different units in the fertiliser plant, namely lignite gasification, gas purification, ammonia synthesis, urea synthesis, sulphuric acid, ammonium sulphate and all other auxiliary units and suggest solutions to problems which have prevented the units from continued designed capacity operation;
2. Assist in break-down maintenance and plan and establish schedules and demonstrate preventive maintenance in all critical units;
3. Help develop and maintain suitable machine maintenance cards, maintenance work requisition forms and maintenance cost control sheets;
4. Establish minimum spareparts list in stores and help order required critical spareparts or help fabricate spareparts;
5. Assist to revamp lubrication schedules if necessary and assist in rationalisation and control of lubrication system;
6. Help to organise workshop facilities for speedy and correct execution of orders. Establish items of additional equipment needed if any and assist order them;
7. Assist to organise maintenance groups for each unit or reinforce a central system. Help train engineers, technicians, mechanics, fitters, etc. in their jobs;
8. Co-operate with local management and team leader in solving any other problems connected with mechanical maintenance of the plant in order to bring the plant to continued full production.

Qualifications: Advanced degree in mechanical engineering with extensive experience in maintenance problems in a fertiliser plant using processes such as oxygen gasification of lignite, high pressure synthesis of ammonia, urea synthesis, etc. Capacity to make innovation and to locally fabricate spareparts and to be a leader in maintenance groups necessary. Experience in developing countries will be an advantage.

Language: English

Background information: The only nitrogen fertiliser plant of the country is situated at Mae Moh, Lampang, Northern Province. It is designed to produce per year 26,000 tons of nitrogen (in end products) based on 330 working days using lignite as raw material to produce ammonia. The designed capacities are as follows (tons/year): -

Ammonia	33,000	
Urea	28,000	
Sulphuric acid	48,000	
Ammonium sulphate	63,700	(all in round figures)

Although the production was started in 1967, the full year of operation was only attained in 1970. Even in this year only 41% of designed capacity was reached in the ammonia plant. One of the main difficulties in attaining continued full production is break-down of equipment very often and it is expected that good break-down and preventive maintenance will help to improve the situation.

The Chemical Fertilizer Co. Ltd. (CHEMFERCO) which owns and operates the plant (majority owned by Thai Government) has requested UNIDO assistance through the TRI for a team of experts to help solve the technical problems and bring the plant up to designed capacity production. Thailand presently imports about US $ 25 million worth of fertilisers. Hence, the importance of increasing local production is evident and the Government gives top priority to the request.

Request from the Government of Thailand

Draft Job Description

Post title: Electrical cum instruments engineer
Fertiliser plant

Duration: Eight months

Duty station: Mae Moh Chemical Fertilizer Plant, Lampang, Thailand

Duties: The expert will be a member of a three-man team working under a team leader and will be assigned to the chemical fertiliser plant at Mae Moh and will be expected to:

1. Review the electrical energy supply problems including interruptions, voltage, etc. and analyse the causes of breakdowns due to electrical maintenance of motors, switch-gear, setting of limit and overload relays, transformers, etc. as well as problems connected with repair and maintenance of process control instruments in the different electrical substations and the different units in the fertilizer plant, namely lignite gasification, gas purification, ammonia synthesis, urea synthesis, sulphuric acid, ammonium sulphate and all other auxiliary units and suggest solutions to these problems which have prevented the units from continued designed capacity production.

2. Assist in break-down maintenance and plan and establish schedules and demonstrate preventive maintenance in all critical units.

3. Particularly assist in resetting overload relays and time relays of all equipment. Assist solve problems connected with starting up of high horse-power synthesis gas compressors together without tripping out other equipment. Assist study and reset automatic shutdown relays. Help solve maintenance connected with insulation of high-tension open motor windings.

4. Help develop and maintain suitable maintenance cards for electrical equipment and instruments, maintenance work requisition forms and maintenance cost control sheets.

5. Establish minimum spareparts list in stores and help order required critical spareparts or help fabricate spareparts.

6. Help to organise electrical and instruments repair shops. Establish list of additional equipment needed if any and assist order them.

7. Assist to organize maintenance groups for each major unit of plant or reinforce central system. Develop safety procedures and train engineers, technicians, electricians and instruments repair and maintenance mechanics in their jobs. Establish job descriptions.

8. Co-operate with local management and team leader in solving any other problems connected with electrical and instruments maintenance in order to bring the whole plant to continued full production.

Qualifications: Advanced degree in electrical engineering (qualification in instruments engineering preferable). Extensive experience in electrical maintenance and instruments repair problems in large fertilizer plants using processes such as oxygen gasification of lignite, high pressure synthesis of ammonia, urea synthesis, etc. Capacity to make innovation and to locally fabricate spareparts and to be a leader in maintenance groups necessary. Experience in developing countries will be an advantage.

Language: English

Background information: The only nitrogen fertilizer plant of the country is situated at Mae Moh, Lampang, Northern Province. It is designed to produce per year 26,000 tons of nitrogen (in end products) based on 330 working days using lignite as raw material to produce ammonia. The designed capacities are as follows (tons/year):

Ammonia	33,000
Urea	28,000
Sulphuric acid	48,000
Ammonium sulphate	63,700 (all in round figures)

Although the production was started in 1967, the full year of operation was only attained in 1970. Even in this year only 41% of designed capacity was reached in the ammonia plant. One of the main difficulties in attaining continued full production is due to difficulties of getting continued supply of electrical energy, line faults, maintenance and repair problems of electrical equipment and instruments.

The Chemical Fertiliser Co. Ltd. (CHEMFERCO) which owns and operates the plant (majority owned by Thai Government) has requested UNIDO assistance through the TRI for a team of experts to help solve the technical problems and bring the plant up to designed capacity production. Thailand presently imports about US $ 25 million worth of fertilizers. Hence, the importance of increasing local production is evident and the Government gives top priority to the request.

Request from the Government of Thailand

Draft Job Description

Post title: Senior Fertiliser Planning Adviser

Duration: One year with possibilities of extension

Duty station: Bangkok, Thailand with travel in the country as necessary. He will be attached to the Prime Minister's Committee dealing with fertiliser matters and work in close collaboration with TRI and the Management of the Chemical Fertiliser Co. Ltd., the Ministry of Finance, etc.

Duties: The adviser will be responsible for assisting the Government of Thailand for long-range planning on all matters related to fertilizer production, imports and consumption. He will be expected to:

1. Assist in setting up a fertiliser planning cell with himself as the leader and consisting of production experts, engineers, economists, marketing experts, etc. who will be mainly Thai experts and where needed to request and augment the cell with foreign experts.

2. The fertiliser planning cell will study all relevant problems connected with the fertiliser industry such as present demand, future demand up to 1980 for various types of fertilisers, namely N, P, K and N-P-K compounds taking into account the agricultural development and soil conditions, imports needed and import policy, further production capacity needed, location, raw materials, types of products, marketing and distribution, price supports, legislation, revamping present production capacity, infrastructure, etc.

3. After the decision on new capacities, location and products are taken to help in drawing-up tender specifications, analyses of tenders, financing arrangements and in helping the execution of the project such as placing orders, drawing up contracts, supervision during start-up, ensuring guarantee performance, etc.

4. Help in drawing up the framework for a permanent institutional set-up in Thailand for handling all matters concerning fertilisers such as a Fertiliser Authority of Thailand (FAT) under which all planning, production units, marketing, research and development, etc. will take place. FAT may have i.a. the following functions: -

- Planning for future fertiliser industry
- Production
- Maintenance
- Construction of new units
- Marketing and distribution and extension services
- Credit
- Financing
- Legislation
- Imports
- Training
- Research and development
- Information

Qualifications: Advanced degree in engineering and/or economics with experience in planning of fertilizer industries in developing countries.

Language: English

Background information: The only nitrogen fertilizer plant of the country is situated at Mae Moh, Lampang, Northern Province. It is designed to produce per year 26,000 tons of nitrogen (in end products) based on 330 working days using lignite as raw material to produce ammonia. The designed capacities are as follows (tons/year): -

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Although the production was started in 1967, the full year of operation was only attained in 1970. Even in this year only 41% of designed capacity was reached in the ammonia plant. The technical troubles were mainly connected with the lignite gasifier using Koppers oxygen gasification process.

The Chemical Fertiliser Co. Ltd. (CHEMFERCO) which owns and operates the plant (majority owned by Thai Government) has requested UNIDO assistance through the TRI for a team of experts to help solve the technical problems and bring the plant up to designed capacity production. Thailand presently imports about US $ 25 million worth of fertilisers. Hence, the importance of increasing local production is evident and the Government gives top priority to the request.

Further in order to help the long-term planning for the development of the industry, the Government of Thailand requests assistance of a planning adviser.

United Nations
Development Programme

Programme des Nations Unies
pour le Developpement

Tel: 57001-3

Office of the Regional Representative
548, Ploenchit Road
P.O. Box 618
Bangkok, Thailand

Ref. TNA/1-571
TNA/1-11
ECAFE/1-1
Letter No. 181

1 March 1971

Dear Dr. Charoen,

In following up on our discussion at my office on 26 February, I am pleased to be able to confirm that the new ECAFE/UNIDO post for a Regional Adviser on Petrochemical Industries is likely to be filled within the next few months.

It would then, I hope, be possible for us to respond immediately on your request for assistance by an ECAFE/UNIDO Regional Adviser in the plastics industry field which was formally submitted by DTEC to this office on 6 October 1970.

I am also very pleased to be able to inform you that I received a cable from Vienna confirming that Mr. Verghese, Chief of Fertilisers, Pesticides and Petrochemicals Industries Section, UNIDO, will be able to come to Bangkok for two days after his Rangoon mission. The probable dates for his visit to Bangkok are 15 and 16 March. I will contact you later to fix a time when we can have discussions at the Department of Science.

Yours sincerely,

Nils Rønn-Ericson
Industrial Development Field Adviser
(UNIDO)

Dr. Charoen Vajirarungsri
Chief
Division of Physics and Engineering
Ministry of Industry
Bangkok

cc: Mr. Wali, UNDP, Bangkok
Mr. Siddiqui, UNIDO, Vienna
Mr. Verghese, UNIDO, Vienna
Field Advisers Support Unit, UNIDO, Vienna
Mr. Manos, ECAFE, Bangkok
Mr. Dilmahit, ECAFE, Bangkok

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Bangkok, Thailand

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"UNDEVPRO" BANGKOK

Ref. THA/1-571
THA/1-11
THA/1-22
Letter No. 362

18 March 1971

Dear Siddiqui,

Subject: THAILAND: Industrial Research Activities requiring Foreign Aid during the Third Plan Period 1972-76

Please refer to my letter to you of 2 March 1971 on the above subject.

During Mr. Verghese's visit here we had a meeting at the Department of Science, Ministry of Industry, with Dr. Charoen, Miss Oonsombat, and Mr. Wallden, the Project Manager of TISI, following up on the Department of Science projects No. 5 b and d in the list attached to my letter of 2 March.

Dr. Charoen handed over a short description of project No. 5 d "Controls and Efficiency Improvement for Industries". It was suggested that UNIDO Headquarters urgently comment on the project and prepare a draft job description for one long-term expert to assist the Department of Science in carrying out his project. Such a draft would then be used as basis for further discussions here. Alternatively, I would like to suggest, as a first step, a 2-3 weeks preparatory mission under SIS by a UNIDO staff member or short-term consultant with the tasks to advise and make recommendations vis-à-vis the implementation of this project and requirements of technical assistance in that connexion.

We also followed up with Dr. Charoen regarding the request by the Department of Science for assistance in the field of plastics and rubber by an ECAFE Regional Adviser (ref. my letter of 1 March 1971 to Dr. Charoen, copied to you, and your letter of 25 November 1970 to Mr. Wali). Dr. Charoen handed over to us for advance information a job description (copy attached) for a six-months SIS-expert -Mechanical Engineer or Chemical Engineer (Plastics Equipment and Machinery Expert) and a list of equipment for plastics study and testing (copy attached). It was suggested that the assistance in this field be provided initially, by the UNIDO/ECAFE Regional Adviser on Petrochemicals when he comes.

Mr. M.A. Siddiqui
Chief of Section for Asia
Technical Co-operation Division
UNIDO
P.O. Box 707
A-1011 Vienna, Austria

However, should Dr. Herbert May, in connexion with the planned mission to Burma on the polymer research laboratory, be able to make a short visit to Bangkok this would be most welcome.

As regards to the equipment, it was suggested that the list be reviewed by the Regional Petrochemicals Adviser and the possibilities explored whether some of the equipment might be provided for under the possible 2nd phase of the SF assistance to the Thai Industrial Standards Institute (TISI).

Please also refer to your letter to me of 10 November 1970 with attached draft job description for an Economist (plastic market) and Mr. Verghese's further letter to me of 9 February 1971 regarding the discussions in Vienna on the same subject with Miss Oonsombat. I was met with positive response during a meeting on 11 March at the Board of Investment with Dr. Amnuay Viravan and Mr. Chira Panupong, regarding their interest in following up by requesting under SIS an expert to assess and make recommendations concerning the development of Thailand's plastics industry along the lines of the draft job description (ref. my letter of 1 March 1971 to Dr. Amnuay Viravan, copied to you). One addition to the job description suggested by Dr. Amnuay was that it should also cover advice on possibilities for export.

Dr. Charoen expressed keen interest in the early carrying out of such a Board of Investment sponsored study which would be of basic importance for the further work in this field at the Department of Science.

Finally, I am also attaching a copy of a description prepared by Dr. Charoen for the project No. 5 c (in the Department of Science list transmitted to you under cover of my letter of 2 March 1971) "Industrial Products Analysis and Testing Service". Although no expert assistance is foreseen for this project, UNIDO Headquarters comments would be most welcome.

Yours sincerely,

Nils Ramm-Ericson
Industrial Development Field Adviser
(UNIDO)

cc: Dr. Charoen, Department of Science, Bangkok
Mr. Walldon, Project Manager, TISI, Bangkok
Mr. Power, UNDP, Bangkok
Mr. Stepanek, UNIDO, Vienna
Mr. Verghese, UNIDO, Vienna
Mr. Saenger, UNIDO, Vienna
Field Advisors Support Unit, UNIDO, Vienna

Request from the Government of THAILAND for Special Industries Services

Job Description

Post title: Mechanical Engineer or Chemical Engineer (Plastics Equipment and Machinery Expert).

Duration: Six months.

Date Required: As soon as possible.

Duty Station: Bangkok, with travel as required.

Purpose of Project: The project is a part of the Economic Development Plan carried out at the Department of Science, Ministry of Industry, with the purpose of improving the local industries. Since the plastic industry is one of the predominant industries in Thailand. The plastic consumer products are very well known in the market of Thailand and the rate of consumption has a tendency to increase rapidly, even all resin raw materials are imported. The purpose of the project as the following:

- to improve and to promote the technical know-how in plastic processing.
- to initiate the production of resin raw materials for supply the local plastic industry.
- to study and research in the use of plastic raw material in other field of industries.
- to look for the new material and process for future plastic industries.
- to study the plastic products industry in automotive industry, the food packaging industry, the building industry etc.
- to study the present and future of the plastics machinery industry in Thailand.

Duties: The expert will:

- study the existing situation regarding plastics fabrication equipment in the country.
- to help the Department of Science in establishing and operating a plastic testing laboratory.

- to make recommendation regarding improvement which can be effected in the plastics fabrication industry.
- to estimate the future requirements of plastics fabrication equipment.
- to suggest courses for training in fabrication techniques, quality control, maintenance of equipment and suggest methods of improving designs of molds, increasing the utilization time, improving quality, etc.
- to recommend the means of strengthening the manpower, equipment and machines for the plastics fabrication industry.

Qualifications: University degree in mechanical engineering or chemical engineering.

Relevant Experience: At least five years experience in the field of design, fabrication or operation of plastics fabrication machinery or in manufacturing plastics fabrication machinery and equipments.

Language: English

Background Information: At present, the plastic industry is one of the predominant industries in Thailand. Most of the plastic industries were been producing consumer articles for daily use. But only small fraction of the total amount of resin raw material is used as the raw material in other field of industries. There are estimated to be 300-350 plastics fabrication plants in Thailand. Approximately 5% of these plants are significant in size with employment ranging up to 200 in the largest plants engaged solely in plastics fabrication. The majority of the plant is small scale employing 10 people or less. In addition significant quantities of plastics materials are used as a component by plants producing such end products as insulated wire and cable, water based paints and paper and wood products utilizing adhesives and coating.

[redacted]

[redacted]

[redacted]

[redacted]

1. [redacted]
2. [redacted]
3. [redacted]
4. [redacted]
5. [redacted]
6. [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

the equipments for research study and testing of plastic material and to plan training courses at international level and for worker members of local factories. This institution, with the help of the project advisor, will establish and maintain necessary contact with the existing managers of the factories involved in the improvement aspect of plastics industries. For such purposes, equipments and facilities are required for the establishment of the institution.

[redacted] At present, the plastic products are very well known in the market of Thailand and the rate of consumption has a tendency to increase rapidly. The plastics industries usually import the raw material for producing consumer products. Recently few factories have received permission for processing plastic resins in order to supply local plastics industries. However, the consumer products are limited in varieties and the application of plastic resins is not as much as it should be because of lacking in equipments for using in carry out investigation and research for seeking of suitable process. This industry is also needed for improvement. Therefore the Department of Science has organized the project for improvement and promotion of this kind of industry. The purpose of this project is to carry out investigation and research for seeking out suitable process, to study the properties of the products and the raw material with respect to development of the process and manufactured products, to assist the industry in solving the problems involved in production, and to investigate new ways for utilization of raw materials.

For the above mentioned purposes, it is necessary to establish or provide the type of researchers for studying and carrying out this project programme. The project should include a supervisory and training programme which will offer technical service to industry. Therefore, it is important that this project has to ask for the plastic equipments to carry out these mentioned programme.

Annex 30

BJamilla/gj
cc: Mr. Verghese

OA 220 THAI

10 November 1970

Dear Nils,

During our meeting with UNDP's erstwhile Resident Representative in Thailand, Mr. P. Aylen, the possibility of UNIDO assistance in the fields of fertilisers and pesticides production and plastics processing was discussed.

Mr. Aylen was of the opinion that an offer of UNIDO assistance in fertiliser and pesticides fields would be premature at this stage but there is a distinct possibility for UNIDO to develop an SIS project in Thailand to advise the Government on the feasibility of developing the local production of plastic resins and improve the ..... plastics fabrication industry. Accordingly we enclose herewith a draft job description for your consideration and action.

Kindly inform us in due course of any development related to this proposal.

With kind regards,

Yours sincerely,

M.A. Siddiqui, Chief
Section for Asia and the Far East
Technical Co-operation Division

Mr. Nils Romm-Grioson
UNIDO Ind.Dev.Field Adviser
UN Development Programme
P.O. Box 618
Bangkok, Thailand

Request from the Government of Thailand
Special Industrial Services

Post title: Economist (plastics market survey)

Duration: 3 months

Date required: As soon as possible

Duty station: Thailand

Purpose of project: To study the domestic market for plastics products, to formulate an estimate of the probable future demand during the next 10 years and to investigate the possibility of the establishment of a local plastics fabrication industry.

Duties: The expert will serve as a Government adviser and his duties will include the following:

- Assess the present domestic market for various plastics products.
- Forecast the requirements during the next 10 years.
- Study the availability and cost of the necessary inputs to develop a plastics processing and fabrication industry in the country, such as labour, utilities, distribution, etc.
- Study the price structure for plastics products.
- Recommend the steps to be taken to increase the consumption of plastics products, including sales promotion.
- Study the feasibility of further development of the local plastics fabrication industry and the establishment of local production of the main types of plastic resins.
- Recommend the scope of any subsequent UNIDO assistance in this field, as required.

Qualifications: University degree in economics with a broad experience of market studies and sales of synthetic resins and plastics products such as film, sheet, extruded or moulded products.

Language: English

Background information: The Government of Thailand desires to investigate the possibility of development of a plastics fabrication industry to supply the growing home market, to diversify the economy of the country at present dominated by agriculture, and to provide employment possibilities.

ECAFE/4-12
Letter No. 175 12 March 1971

Dear Dr. Kansu,

Please refer to Mr. Verghese's, Mr. Skoumal's and my meeting with you and Mr. Karaoglan on 11 March 1971, inter alia concerning possible UNIDO assistance in connection with the United Nation's Research Project on ASEAN Economic Co-operation (the Study on ASEAN Economic Co-operation). I am pleased to send to you the draft project descriptions based on our discussions, for assistance, under the Special Industrial Services (SIS) programme, in the undertaking of a study in depth of fertilizer industry.

As agreed at the meeting, the next step might be your approaching the ASEAN contact officers in the five countries as indicated in my earlier letter of 19 February 1971 regarding similar assistance projects. If positive response is obtained, then the Government endorsement of the project should be submitted through the formal channels (the technical assistance co-ordinating bodies of the respective Governments) to the UNDP Resident Representative in each country for his forwarding to UNDP and UNIDO Headquarters (with copy to your office).

We would also appreciate if you could indicate to us as soon as possible the result of your discussions on this matter with the ASEAN contact officers so that we, if deemed desirable, might initiate advance recruitment action.

Yours sincerely,

Nils Ramm-Ericson
Industrial Development Field Adviser
(UNIDO)

Dr. G. Kansu
Team Leader
ASEAN Study Group
R.S. Hotel
Bangkok

cc: Mr. D. Blickenstaff, UNDP, Djakarta
Mr. A. Campbell, UNDP, Kuala Lumpur
Mr. W. Harding, UNDP, Manila
Mr. W. Wali, UNDP, Bangkok
Mr. W. Jones, UNIDO, Field Adviser, Manila
Mr. K. Dikshit, ECAFE, Bangkok

Mr. M.A. Siddiqui, UNIDO, Vienna Mr. G.S. Gouri, UNIDO, Vienna
Mr. E. Rothblum, UNIDO, Vienna Mr. M.C. Verghese, Vienna, UNIDO
Field Advisers Support Unit, UNIDO, Vienna

Mr. S. Skoumal, Systems and marketing consultant, UNIDO, Bangkok

PROJECT FOR UNDP-UNIDO ASSISTANCE UNDER
THE SPECIAL INDUSTRIAL SERVICES (SIS) PROGRAMME

Project title: ASEAN Co-operation in the Development of Fertilizer Industry (In-depth Study)

Countries: The ASEAN member countries - Indonesia, Malaysia, the Philippines, Singapore and Thailand.

Project Description:

The objective of this project is to explore in depth - based on the preliminary studies currently being undertaken by the ASEAN Study Group - the possibilities of co-operation between the ASEAN countries in the further development and production of fertilizers, e.g. by preparing an analytical report on the existing fertilizer production facilities in the five countries, the projected needs of the five countries till 1980 taking into account population growth, the rise in standard of living and higher nutritional standard, raw materials availability, substitution of imports and generally on the basis that fertilizers are the most important input in the development of agriculture leading to the "green revolution". The study should also include capacity estimates, locations and preliminary investment cost requirements. For this purpose the services of a fertilizer industry specialist (chemical engineer-cum-economist) is requested for a period of six months during the latter part of 1971. The expert will be a member of the ASEAN Study Group based in Bangkok.

Background information:

Most of the countries of the ASEAN Group - Indonesia, Malaysia, the Philippines, Singapore and Thailand - are countries with large exports of agricultural commodities. To continue to develop this sector, the input of fertilizers is a major requirement. At present, two production units for nitrogen fertilizers exist in Indonesia, one in the Philippines and one in Thailand. In Indonesia, a very detailed study to set up a large size fertilizer plant using natural gas, as the raw material has been contracted by the World Bank and the US AID. The small fertilizer unit in Thailand is based on lignite and is not meeting the increasing needs of the country.

Under the above conditions the scope for the development of this sector and its integration among the countries is urgent. Cheap and extensive raw materials such as oil, gas and naphtha exist in some of the countries and demand for fertiliser is growing. It is estimated that in Thailand alone the import of fertilizers is of the order of US $25 millions a year. Thus with availability of raw materials and present and potential demand this sector of industry has a bright future for development.

This study in depth will draw up on the information contained in the UNIDO Study presently being finalised for the ECAFE region namely "Survey of Fertiliser Production Facilities", as well as the extensive study the World Bank is sponsoring in Indonesia".

The ASEAN Study Group, established for the United Nations' Research Project on ASEAN Economic Co-operation (the Study on ASEAN Economic Co-operation), is currently undertaking a study on the fertiliser industry in which they will make a preliminary identification of the possibilities of co-operation among the ASEAN countries as well as specify methods for such co-operation. The SIS assistance under this project is to be considered as the next stage after which the matter will be expected to be pursued by the countries concerned for implementation by the industry.

United Nations Development Programme

Programme des Nations Unies pour le Developpement

Tel. 57001-3

Office of the Regional Representative
548 Ploenchit Road
P.O.Box 618
Bangkok, Thailand

Ref. ECAFE/1-1
Letter No. 367

23 March 1971

Dear Siddiqui,

ECAFE: Regional Advisers

I have recently reviewed with Dr. C.Y. Li, Mr. Dikshit and Mr. Manos the present position of the five Regional Adviser posts at ECAFE financed under UNIDO's Regular Programme. The situation, I understand, is as follows:

During Mr. Dikshit's programme discussion at Vienna at the end of November 1970 ECAFE and UNIDO had agreed that, subject to final concurrence, the five Regional Adviser posts would be on the following disciplines:

1) Iron and Steel (Mr. Abrera)
2) Agro and Light Industries (Dr. Reddy)
3) Plastics Engineering and Tools
4) Agricultural Machinery
5) Industrial Training

However in December 1970, UNIDO informed ECAFE that the five posts would be for the following:

1) Iron and Steel
2) Agro and Light Industries
3) Agricultural Machinery
4) Petrochemicals
5) Industrial Economist

ECAFE wrote on 5 January 1971 to Mr. J.E. Stepanek, with copy to Mr. G.S. Gouri, saying that they agreed to UNIDO suggestion except that in the place of agricultural machinery they would like to have industrial training as requested by UNIDO and also because ECAFE had already the services of an expert on agricultural machinery available.

Mr. N.A. Siddiqui
Chief
Section for Asia
Technical Co-operation Division
UNIDO
P.O. Box 707
A-1011 Vienna
Austria

2/A cable .....

A cable was sent to Mr. J.E. Stepanek on 3 March 1971 requesting him to expedite reply.

For the post in petrochemicals ECAFE would like to have Mr. J.T. Shen, who has earlier been attached to ECAFE and also been UNIDO expert in Singapore. Mr. Shen is presently Chairman of the Board of Directors of the Chinese Petrochemical Corporation in Taipei. Mr. Shen's present address is as follows:

Mr. J.T. Shen
37 Lane 59
Lin Yi Street
Taipei, Taiwan
Republic of China

Mr. Shen's candidature was discussed at a meeting at ECAFE with Mr. Verghese last week.

For the post of Industrial Economist ECAFE is having preliminary discussions with the New Zealand economist, Professor Castle.

Finally, as far as the last post is concerned it would be highly appreciated if UNIDO Headquarters could confirm to ECAFE that this post will be for an Industrial Training Adviser. Please refer to my letter of 23 November 1970 to Mr. Stepanek and Mr. Karlik's letter of 13 November 1970 to Mr. Surjo Sediono on this subject.

Yours sincerely,

Nils Hamm-Ericson
Industrial Development Field Adviser
(UNIDO)

cc: Mr. Dhanbit, ECAFE, Bangkok
Mr. Dowber, UNDP, Bangkok
Mr. Le Cuay, UNIDO, Vienna
Mr. Stepanek, UNIDO, Vienna
Mr. Verghese, UNIDO, Vienna
Mr. Saenger, UNIDO, Vienna
Field Advisers Support Unit, UNIDO, Vienna

Mr. M.A. Siddiqui, Chief
Section for Asia and the Far East, TCD

29 April 1971

Mr. E. Rothblum, Assistant Director, ITD

OA 220 ASR

M.C. Verghese, Chief
Fertilisers, Pesticides and Petrochemicals
Industries Section, ITD

ASIA REGIONAL: Profeasibility Survey on Pesticides and Plant Hormones and their Production in the ECAFE Region.

Please refer to Mr. Terver's letter of 5 April 1971 to Mr. Quijano-Caballero conveying the comments of FAO on the draft Project Data Sheet prepared by UNIDO submitted to FAO on 11 March 1971 and your memorandum of 16 April on the above subject.

As pointed out in our memorandum of 3 March 1971 to you this project was given high priority by the fifth session of the Asian Industrial Development Council in January 1970.

Additionally, recommendation No.51 addressed to the Director-General of FAO from the Tenth FAO Regional Conference for Asia and the Far East held in Canberra, Australia from 27 August to 8 September 1970 stated that:

"A study of the production capacity of the plant protection materials industry in the Region should be undertaken, so as to assist the Member Governments in the development of their production programme - particularly in the formulation of pesticides - and to promote co-operation among them in the most economic use of the regional resources."

Despite the importance attached to this project by the Asian countries, UNIDO and FAO, it was decided by UNDP to keep the project in abeyance because it was believed that it fell within the context of FAO's project proposal GLO-9.

The subject has been examined at the UNIDO/FAO Technical Staff Meeting on the Promotion and Development of Agricultural Pesticides and Fertiliser Industries held in Rome from 15 to 18 February 1971. The meeting concluded that there was no reason to believe that FAO's GLO-9 and UNIDO's OA 220 ASR were overlapping.

Most importantly, Mr. Terver's letter indicates FAO's concurrence in considering UNIDO's project proposal of great importance and high priority and expresses FAO's readiness to co-operate with UNIDO by participating in a joint expert mission that shall conduct the pre-feasibility survey.

The "Green Revolution" has been initiated in ECAFE countries. In order to maintain and further the achievements of the Green Revolution it is vitally important that the protection of high crop yields against pests receive appropriate attention, including the production and use of required pesticides.

We would like to request that TCD take urgent steps to obtain UNDP's approval of our project proposal. It seems to be advisable to resubmit the Project Data Sheet and Job Descriptions as completed and revised by FAO. For your consideration enclosed please find a draft letter requesting UNDP's reconsideration and approval of the project.

drafted: K. Nambo/jw
cleared: ... Verghese, Chief FPP, ITD
cc: Mr. M. Siddiqui
Chief of section
for Asia and the
Far East
cleared: Mr. Quijano-Caballero
Director, TCD

OA 220 APE 30 April 1971

SIS Regional Pre-feasibility Survey on
Pesticides and Plant Hormones .....

Dear Mr. Cohen,

Please refer to our letter of 21 January 1971 concerning UNIDO's project proposal in the above subject, in which we pointed out that this project was originated and given high priority by the Fifth Session of the Asian Industrial Development Council held in Bangkok in January 1970.

Independently, recommendation No. 17 of the Director-General of FAO from the Fourth FAO Regional Conference for Asia and the Far East held in Canberra, Australia from 27 August to 5 September 1970, stated that

> "A study on the production [illegible] of the plant protection materials industry in the Region should be undertaken, so as to assist the Member Governments in the development of their production programmes, particularly in the formulation of pesticides and to promote co-operative ventures between them in the most competitive use of the regional resources."

As you know UNIDO decided to keep this project in abeyance but as it has been thought that the proposed study on this subject of UNIDO's project proposal FAO, as indicated in your letter of 5 October 1970

The subject has been since discussed at the UNIDO/FAO Technical Staff Consultation on the Promotion and Development of Agricultural Pesticides and Fertilizer Industries held in Rome from 1 to 5 February 1971. The meeting reached the conclusion that there was a need to ensure that FAO's [illegible] and UNIDO's [illegible], the subject project, would be overlapping.

Moreover, FAO showed great interest in participation in UNIDO's project by delegating a pesticide specialist to the survey mission and utilization of obsolete pesticides as proposed in Mr. Nambo's letter of 5 April 1971. A revised draft of description on this export part was also sent by FAO to UNIDO at the same time.

Mr. Ivor Cohen, Assistant Administrator
and Director, Bureau of Operations and Programmes,
United Nations Development Programme
New York [illegible] USA

In order to maintain and further the achievements of the Green Revolution, the protection of high crop yields, through appropriate use and protection of pesticides, is evidently necessary. This applies to the ESAFE actions probably more than to any other region.

Thus, we would like to request that ESCAP reconsider its stand on this project and by approving it make it possible for UNIDO and FAO to start, without further delays, a joint pesticides programme much needed by the Region.

Yours sincerely,

S. [illegible]
Director
Technical Co-operation Division

[redacted]

1. [redacted]

2. [redacted]

3. [redacted]

[redacted]

[redacted]

[redacted]

At its recent executive meeting, the Asian Industrial Development Council approved action on the progress of [redacted] for undertaking a Pre-Feasibility Survey of [redacted] on Plant Hormones, as a priority item. [redacted] of action [redacted] by UNIDO on the development of [redacted] the [redacted] on the training of personnel in various aspects of the synthesis and formulation of chemical pesticides, [redacted] is requesting assistance from UNIDO in undertaking the above survey.

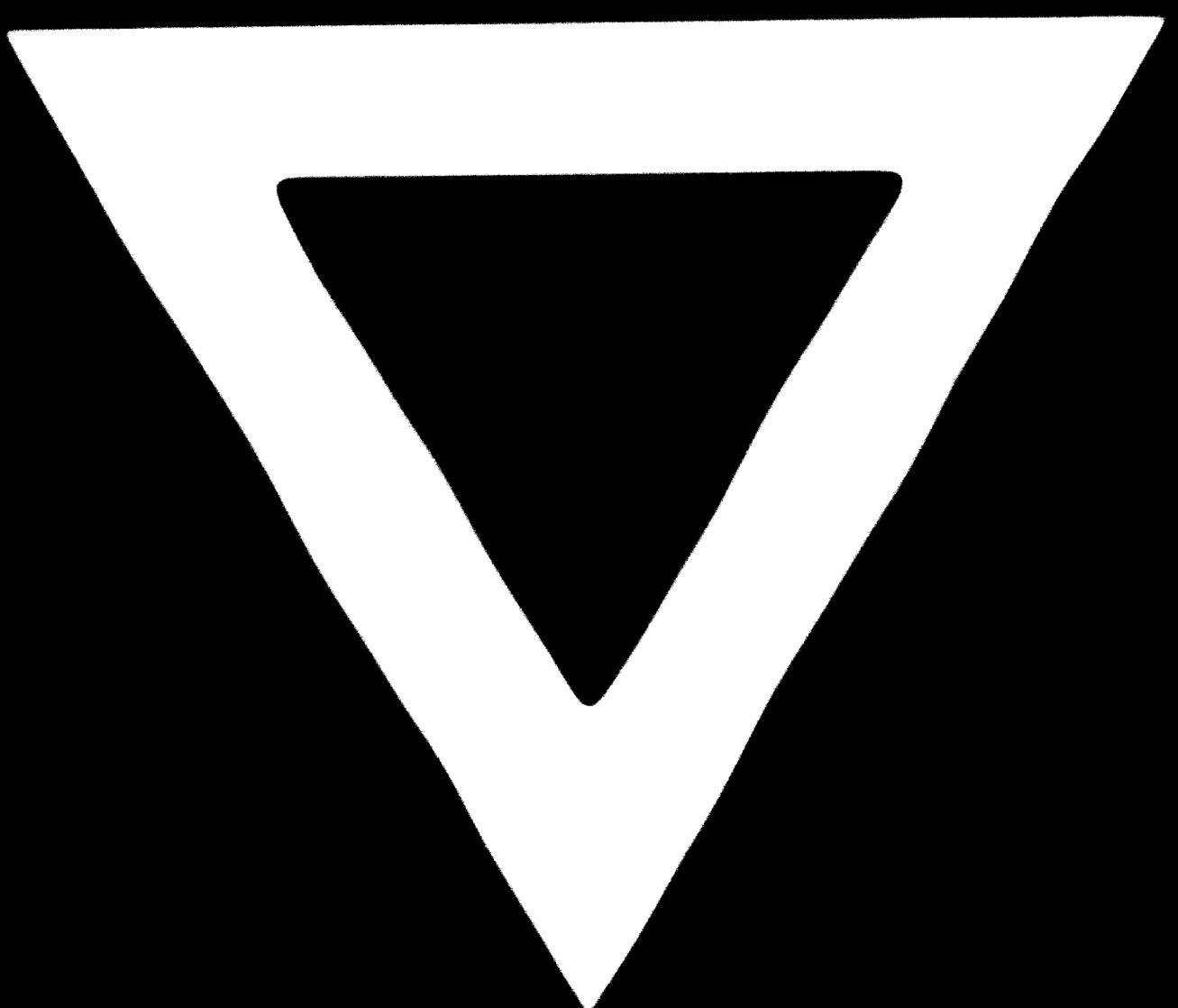
Originally, a memorandum [redacted] addressed to the Director-General of FAO from the Tenth FAO Regional Conference for Asia and the Far East held in Canberra, Australia from 31 August to 7 September 1970 stated that

"In view of the production capacity of the plant protection chemicals industries in the Region already in existence, or to be added in the further future Governments in the development of their production programmes - particularly in the formulation of pesticides - may be prepared to undertake economic study only in the most economic use of the chemical resources."

It is felt that requests for [redacted] will emerge from the survey.

[redacted]

C - 827



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