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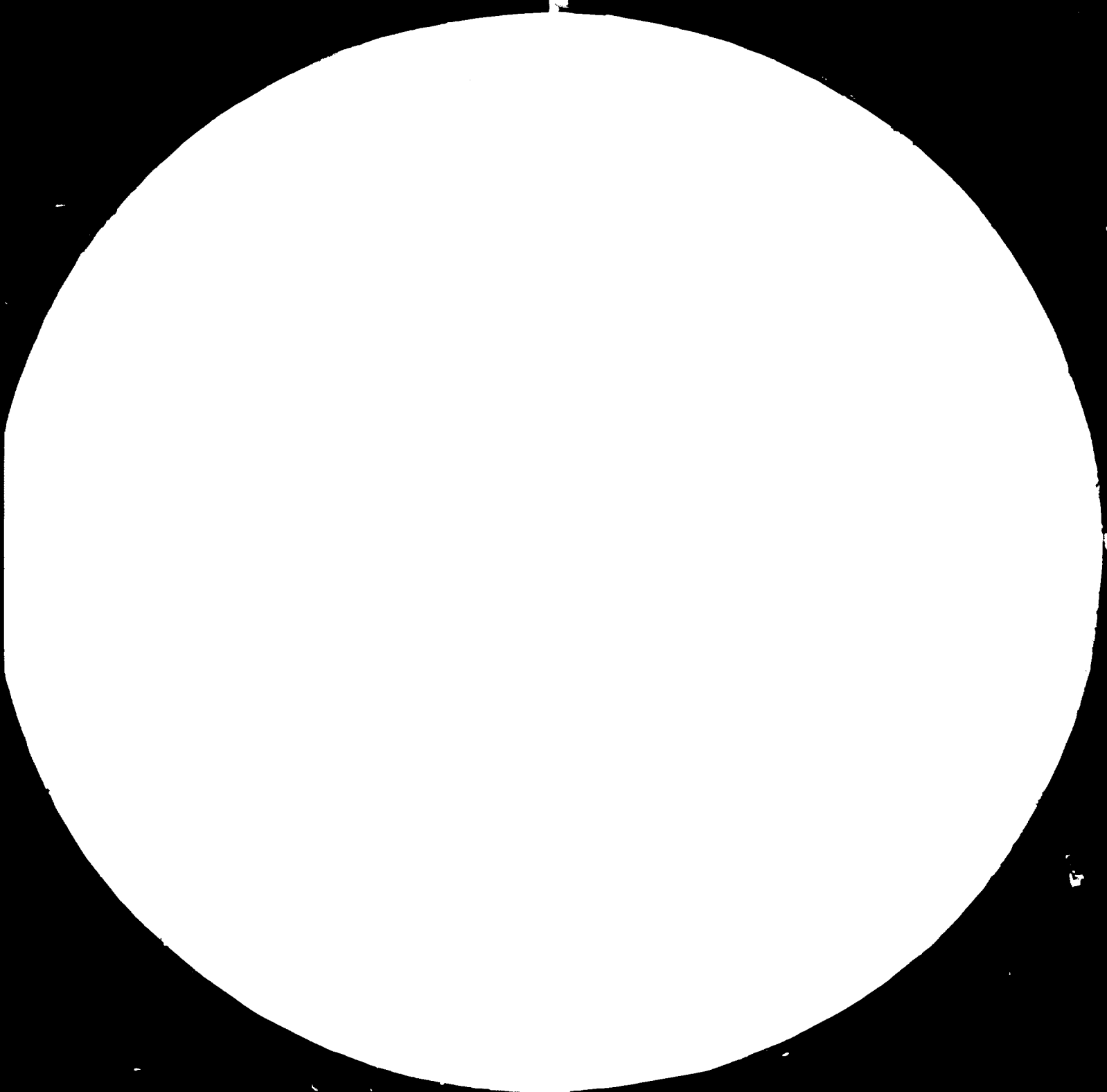

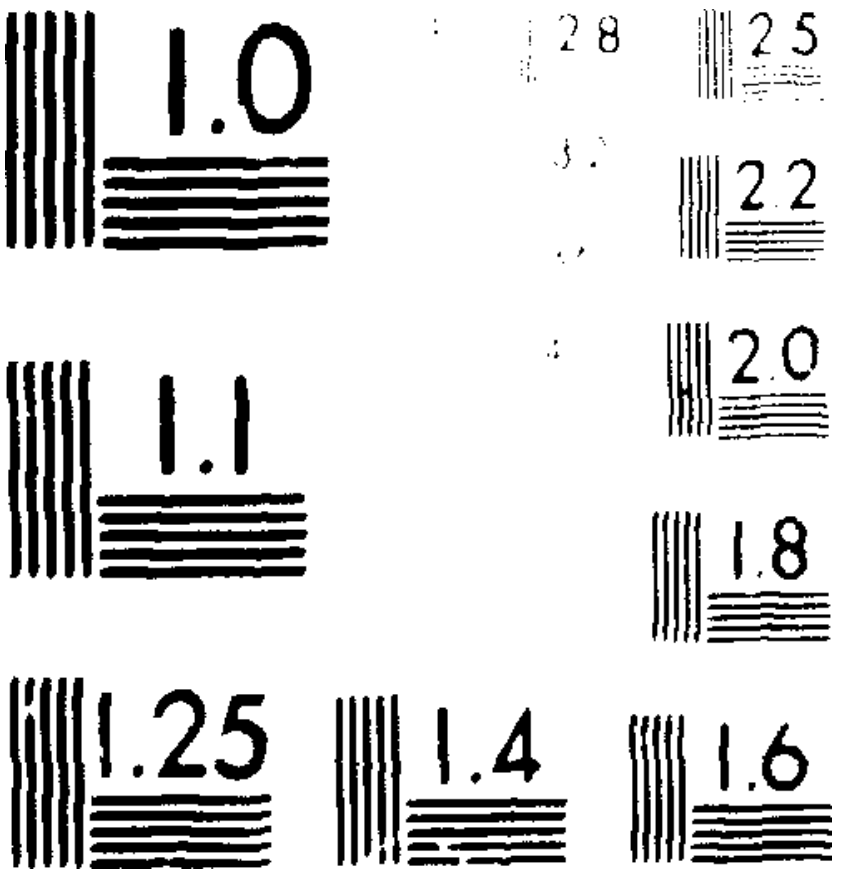

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English

OPERATION AND MANAGEMENT OF FERTILIZER PLANTS

DP/BGD/78/002

BANGLADESH

Terminal report *

Prepared for the Government of the People's Republic of Bangladesh
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Wybe G. Wals, training adviser for phosphate plants

United Nations Industrial Development Organization

Vienna

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ANNEX

ACKNOWLEDGEMENT

The training adviser wishes to acknowledge the whole hearted cooperation extended by the management and the staff of TSP Fertiliser Complex Ltd. Chittagong and their valuable assistance in the implementation of the task of the training adviser.

Particular mention is made of the help and contribution of the following managers of TSP Complex :

Mr. S.A.K.M. Delwar Hussain, General Manager
Mr. Mohammad Sadeque, Additional Chief Operation Manager
Mr. Md. Sufian Ahkand, Training Manager

Thanks are due to the UNIDO representatives at UNDP headquarters Dhaka, headed by Mr. Bark Kocer, Senior Industrial Development Field Adviser, and in particulary his Programme Officer, Mr. Ad de Raad, for their support in difficult matters and circumstances.

Thanks are also due to Mr. Walter Holzhausen, Resident Representative UNDP Dhaka and his staf in particularly his Deputy Resident Representative Mr. Michael P. Hyland, and his Administrative Assistance in Chittagong sub-office Mr. Neville C. Harney, who were helpful and provided all facilities.

Mr. C. Kaleti (retired), back stopping officer UNIDO, Vienna had taken a keen interest in the training methods and had provided useful information and advice, for which the training adviser expresses his grateful thanks.

Last but not least, the training adviser expresses also his grateful thanks to those and in particularly Mr. Ronald D. Young of TVA USA, Mr. Sven-Eric Dahlgren of Boliden Kemi Sweden and Mr. Rune Haakansson of Supra Sweden, for their valuable information for the benefit of TSP Complex.

ABSTRACT

A. Purpose of the project

The purpose of the project is to up-grade the skills of operating and maintenance personnel at the TSP Fertilizer Complex Ltd., Chittagong.

To achieve this purpose, the training adviser has made a training programme, which is shown on a separate sheet in a concised form, see synopsis of training programme, section D.

As achievement by training and advice is difficult to measure, the following aims have been introduced as a kind of training meter.

a. Confidence in own expertise
b. Higher production rates of TSP Complex
c. 100 % Plant capacities and more
d. Continuous running of plants and sections
e. Product quality according to international standards
f. Economic running plants
g. Price of products competitive against price of imported products

B. Achievement

1. Training programme

The activities relating to the training programme have been worked out in this report in detail after having collected and studied the findings at TSP Complex.

These findings were required to find out training methods and advice to achieve the aims mentioned before in section A.

During the stay of the training adviser at TSP Complex the employees have been trained in so called basic engineering , how to operate and maintain the plants and sections by means of training courses and by issueing training manuals.

Those, who know more about operation and maintenance were also trained in other activities, see synopsis of training programme, section D.

2. High-lights of achievement

a. Conifidence in own expertise

b. Selection by an Iraq committee of 22 trained employees of TSP Complex, who applied for a job in Iraq.

c. Maintenance of sulfuric acid plant no. II was caused by poor operation as detected by a trouble shooting team.

d. Training of employees of a private company and supervising its start-up by TSP Complex team resulted in a production of 110 percent of the nameplate capacity of this private company.

e. The increasing of capacities of plants or sections was shown in one day, on Tuesday 21 September 1982, in MT, metric tons, of green TSP of the following reaction sections, i.e. :

TSP-I	:	188.67 MT (nameplate capacity = 100 MTPD)
TSP-II	:	669.76 MT (nameplate capacity = 430 MTPD)
Total		858.43 MT of green TSP

f. The increase of the monthly production was shown in the month of September 1982, which was never shown before :

TSP-I : 2165.06 MT green TSP

TSP-II: 9705.45 MT green TSP

Total : 11870.51 MT green TSP

3. Duration of achievement

The achievement as high-lighted above, was achieved during the contract period of the training adviser :

from 15 October 1980 through 14 October 1982

C. Conclusions and recommendations

It may be concluded from the achievement , mentioned above, that still a lot of aims may be achieved by the training methods and advice of the training adviser, for which the following are recommended.

a. Extension of services

Extension of the services of the training adviser for one year, with possibility of extention.

b. Completion of training programme

Completion of the establishment and implementation of the training programme to be able to achieve the aims as mentioned in section A of the abstract.

c. Fellowships for abroad

Formulation of specialized training programmes for abroad, the guidance of the fellows going abroad and supervising them after their return.

d. Day-to-day matters

Advising in matters relating to day-to-day operation and management of TSP Complex.

e. FIRP, fertilizer industries rehabilitation programme

Advising in matters relating to the implementation of the granulation plant, major overhauling of TSP Complex and other activities regarding improvements.

f. Budget for abroad training

Budget allocations to carry out the specialized training programmes abroad.

g. Budget for training equipment

Inclusion of sufficient funds for the producument of equipment to be used during in-service training for teaching and demonstration purposes.

D. Synopsis of Training Programme for operating and maintenance personnel of TSP Fertiliser Complex Ltd., Chittagong.

Senior Officers	Officers	Junior Officers	Operators	Activity	Aim
═══	═══	═══	═══	Basic engineering	Confidence in own Expertise
═══	═══	═══	═══	Trouble shooting	Higher production
═══	═══	═══	═══	Start-up engineering	
═══	═══	═══	═══	Planning	100% Plant capacities and more Continuous running plants
═══	═══	═══	═══	Research and Development	Product quality. Economic running plants
═══	═══	═══	═══	Engineering	Competitive products

═══ completed, aims achieved.

═══ completed for one or more engineers, aims partly achieved.

═ ═ ═ under training, aims not achieved.

═ - ═ future planning.

Note : Ranks of the officers and operators are shown in Annex II

ABBREVIATION / EXCHANGE RATE

UNIDO	United Nations Industrial Development Organization
UNDP	United Nations Development Programme
BCIC	Bangladesh Chemical Industries Corporation
TSP Complex	TSP Fertilizer Complex Ltd. Chittagong
SIDFA	Senior Industrial Development Field Adviser
BUET	Bangladesh University of Engineering and Technology
TVA	Tennessee Valley Authority, Muscle Shoals, Alabama, USA
IFDC	International Fertilizer Division Centre, Muscle Shoals, Alabama, USA.
FIRP	Fertilizer Industries Rehabilitation Programme(Project)
Ex - PIC	Ex - Plant In Charges
SA - I	Sulfuric Acid plant no. I
SA - II	Sulfuric Acid plant no. II
PA - I	Phosphoric Acid Plant no. I
PA - II	Phosphoric Acid plant no. II
TSP- I	Triple Superphosphate plant no. I
TSP- II	Triple Superphosphate plant no. II
ROP TSP	Run - Of - Pile Triple Superphosphate
OSP	Ordinairy Superphosphate
ESP	Enriched Superphosphate
DDT	Dichloro - Diphenyl - Trichloroethane
BPL	Bone - Phosphate of Lime
BPL % x 0.4576 = P205 %	
WPA	Wet process Phosphoric Acid
HSD oil	High Speed Diesel oil for heating-up furnace of SA - I and for shovel loaders
ADP loan	Annual Development Programme loan allocated by the Government out of foreign credit

KG		Kilogram
MT		Metric Ton
MTPD		Metric Ton Per Day
1 Maund	=	40 Seers = 37.21 Kg.
1.075 Seer	=	1 Kg.
1 GAL.	=	1 Imperial Gallon = 4.536 Liters

Tk		Taka, the currency unit of Bangladesh
1 Lac Tk	=	100,000 Takas
1 Crore	=	100 Lac

Exchange rate fixed by UNDP Dhaka.

October, November	1980	: 1 US $	= Tk. 15.60
Per 1 December	1980	: 1 US $	= Tk. 16.00
Per 1 January	1981	: 1 US $	= Tk. 16.45
Per 1 May	1981	: 1 US $	= Tk. 17.30
Per 1 June	1981	: 1 US $	= Tk. 17.55
Per 1 July	1981	: 1 US $	= Tk. 17.75
Per 1 August	1981	: 1 US $	= Tk. 18.50
Per 1 November	1981	: 1 US $	= Tk. 19.20
Per 1 January	1982	: 1 US $	= Tk. 20.40
Per 1 April	1982	: 1 US $	= Tk. 21.15
Per 1 July	1982	: 1 US $	= Tk. 21.86
Per 1 October	1982	: 1 US $	= Tk. 22.56

I. INTRODUCTION

A. Project background

1.01 UNIDO's assistance was requested by BCIC (Bangladesh Chemical Industries Corporation), a state owned corporation, through their Government of the Peoples Republic of Bangladesh in the form of training to up-grade the skills of operating and maintenance personnel in one of their enterprises, the TSP Fertilizer Complex Ltd., Chittagong, see Annex I.

1.02 The training adviser was requested to work closely with UNIDO's curriculum development adviser as well as with the Japanese team of the firm UNICO International Corp./Nissan Chemical Co., sub-contracted by UNIDO, to carry out the task for improved utilisation of the phosphate fertiliser plant.

1.03 This request is a part of the Operation and Management for Fertiliser Plant project under code number BGD/78/002, to be implemented at the Urea Fertiliser Factory in Ghorasal and the TSP Fertiliser Complex in Chittagong, for which funds was already available at UNIDO headquarters in Vienna, Austria.

1.04 The main target of this project is, that the fertilizer plants produce at least their nameplate capacity, which is, restricted to the TSP Complex, 152,000 MT per year, see Annex I, for which reason the Japanese UNICO team was sub-contracted by UNIDO from October, 1979 to and included November, 1981.

1.05 To produce at least the nameplate capacity is essential for Bangladesh, as this country needs at the moment approx. 300,000 MT, metric ton, of TSP per year, which means that, what can not be produced by TSP Complex have to be imported.

1.06 It has been forecasted that the demand for TSP fertiliser in Bangladesh will increase to 500,000 MT by the year 1990

1.07 B. Job description

The objectives, as mentioned in the job description, and specifically requested to be conducted in the training programme, are as follows :

a. Review the operating manuals provided for sulphuric acid, phosphoric acid and TSP production plants.

b. Assess the skills of the plant supervisors and operating personnel.

c. Co-ordinate the work of the curriculum development adviser and implement the programme of training developed by him.

d. Asses the maintenance organization of the plants and the skills of maintenance supervision as well as operators.

e. Select candidates to participate in the training programme as well as candidates for training followships to be conducted in foreign countries under this programme.

f. Assist on safety programmes to be established at the plants.

g. Assist in improving good housekeeping within the plants.

h. Advise on improvements to be made on environmental aspects of the operation of the plants.

C. Findings

1.08 Investigation has been made to find out how much has already been done by the Japanese team, how the plants were running and what was going on at the TSP Fertilizer Complex Ltd., Chittagong.

1.09 This investigation was required to avoid duplicating of work with relation to the objectives as mentioned in section B, and of which the results would be used as basis of the training programme.

1.10 The results of the findings, which will be discussed more in details in the following chapter, are as follows :

a. No curriculum development adviser has ever been nominated at TSP Fertilizer Complex Ltd. Chittagong . The curricula made by the curriculum development adviser of the Urea Fertilizer Factory at Ghorasal are available and may be used as guidelines.

b. The operating manuals provided for sulphuric acid, phosphoric acid and TSP production plants have been reviewed already by the Japanese team.

c. Maintenance programme and work were under the supervision of a member of the Japanese team. It was observed by the training adviser, that most of the maintenance work was repairing.

d. Safety programmes are known at plant site, but safety equipment such as hard hats etc. are not enough available for all plant operators, mechanics etc.

e. Good housekeeping rules are also known and the rules are described on pocket-size yellow cards and are distributed all over the place at plant site. But these rules are difficult to maintain due to : too much leakages and spillages of materials and too much shut-downs of the plants and sections.

f. Improvement on environment aspects especially the dust pollution is difficult to make due to the wrong design of the dust system by the manufacturing of powder TSP.

g. Courses for apprentices were going on, but most of them could not be absorbed by TSP Fertiliser Complex, after they passed their examination.

h. Courses in process calculation were conducted by the Japanese team-leader for officers and senior officers.

i. Not much funds were available for the project of the training adviser.

j. Equipment for training purposes were already ordered, see Annex III, and sent to TSP Complex, but most of them could not be used due to lack of materials, instruction manuals etc.

k. A building, to be used as training center is available at plant site, see Annex IV.

D. Activities

Based on his findings, the training adviser made his programme. His activities during his stay at TSP Fertilizer Complex Ltd., Chittagong, were re-ported in bi-monthly reports to UNIDO with copies to his counter-part, the Resident Representative of UNDP, Dacca, and to the UNIDO/SIDPA, Senior Industrial Field Adviser at UNDP, Dacca, and are summarized as follows :

a. The preparation of a budget for simulators and equipment for training purposes, of which the summary is shown in Annex V

b. The preparation of a book-list of which funds have been allocated. The books which have already been received up to September 1982 are shown in Annex VI

c. The study of the processes and equipment specifications of the plants.

d. Discussions with the employees about the processes and equipment specifications.

e. Correspondence to several companies as listed in section F, for more detail information.

f. Preparation of training , manuals , see Annex VII, and selecting candidates to participate in the training programme.

g. Organizing training courses for TSP Complex employees, students and employees from other companies.

h. Training of ex PICs, ex Plant In Charges.

i. Organizing and instruction in the form of guidelines for fellowships.

j. Advicing and supporting trouble shooting teams and start-up teams.

k. Advising in minimizing production cost of TSP in connection of raw materials and in the import of WPA, Wet-process Phosphoric Acid.

l. Process calculation, designing and advising in laboratory testing regarding the manufacture of OSP, Ordinary Super Phosphate, and ESP, Enriched Super Phosphate from spent sulfuric acid of the DDT plant.

m. Consultance in granulation plant, FIRP (Fertilizer Industries Rehabilitation Programme), hot gas filter, sulfur filter, etc.

E. Related parties

Execution body	UNIDO/BCIC United Nations Industrial Development Organization/Bangladesh Chemical Industries Corporation.
Project owner	UNDP/GOB United Nations Development Programme/ Government of Bangladesh.
Field work coordination	UNIDO SIDFA/UNDP UNIDO Senior Industrial Development Field Adviser and UNDP.
Counterpart	General Manager of the TSP Fertilizer Complex Ltd., Chittagong. Training Manager of the Training Center of the TSP Fertilizer Complex ltd. Chittagong. General Manager of the Training and Recruitment Section of BCIC, Dacca.

F. Non - related parties

For some detail information, the following companies have been contacted during the training period of the training adviser :

a. TVA, Tennessee Valley Authorities, Muscle Shoals, Alabama, USA.
b. Boliden Kemi AB, Halsingborg, Sweden.
c. Supra AB, Landskrona, Sweden
d. Avesta Jerverks AB, Avesta, Sweden
e. Borregaard Industries Ltd, Sarpsborg, Norway
f. Kemira OY, Helsinki, Finland.
g. Tampereen Verkatehdas OY, Tampere, Finland.
h. Alon Processing Inc., Tarentum, Penna., USA.
i. Munkagaard A/S, Copenhagen, Denmark.
j. Maroc Chemie, Safi, Morocco
k. Office Cherifien des Phosphates, Paris, France

II FINDINGS

The findings in connection with the objectives mentioned in the job de_cription are discussed herewith more in details as follows :

A. Maintenance of the plants

It is a fact that the Japanese team did make all efforts to guide the maintenance personnel for an efficient running of their maintenance department, by issueing guidelines, describing how in Japan the maintenance department is working etc..

It is observed, that the main job of the maintenance department is repairing or replacement of equipment, due to wrong design, wrong material of construction etc., for instance :

1. Ribbon mixer below the TVA cone mixer.
2. Rubberlined slurry pumps instead of 20 Cr - 25 Ni stainless steel slurry pumps.
3. Sulfuric acid distribution trays made of 316 stainless steel instead of Meehanite.
4. Agitators made of ferralium instead of lining with polypropylene, etc ..

Patching the leakages of the ducts, towers and heat exchangers of SA-II, the sulfuric acid plant no. II, is a continously returning job to prevent further damage and to prevent environmental pollution.

Keeping always some maintenance people standby for troublesome equipment like the pan conveyor, ribbon mixer, etc. to minimize shut-downs, reduces the efficiency of the maintenance department.

To reinforce the maintenance department the following actions have been taken :

a. Sending a trouble shooting team to investigate the operation of SA-II from 1974 up till now. The results of this investigation showed, that most of the maintenance work was due to poor operation. Checking through a written examination of the operators showed also a poor result.

b. Full support of the management of TSP Complex on own expertise, proved to work excellent. An example to mention herewith is the replacement of most of corroded tubes of the heat exchanger of SA-I, the sulfuric acid plant no. I, by mild steel tubes and using only some handtools.

The heat exchanger is working now without trouble, and same could be withdrawn from the list of equipment to be purchased from foreign countries.

c. Sending the most experienced engineers to foreign countries, for example, to IFDC, the international fertilizer development center, Alabama, USA, for the training course on maintenance and production management, with the instruction to collect as much as possible data regarding the TVA cone mixer.

This training course could be attended under the sponsorship of UNIDO and the result was that the TVA cone mixer was redesigned, saving TSP Complex a lot of money.

d. From the IFDC training course, a training manual has been prepared and distributed during the lecture in maintenance, at the training center of TSP Complex.

B. Safety programmes.

The management of TSP Complex is fully aware of the importance of safety for their employees, and will do all their utmost to prevent accidents and support all efforts to create a safe working condition.

In case of an accident, the management of TSP Complex has already established a medical center fully equipped with first aid supplies and a staff of qualified physicians, assistances and a number of personnel well trained in giving first aid, to save lives.

Yellow, pocket-size charts mentioning the rules for "Supervisor's daily safety review" have been distributed at TSP Complex, and safety boards mentioning safety rules have been located on survey-able spots at plant site, as a continuous warning to the employees to be aware about safety.

More safety equipment such as rubber gloves, gogles, hard hats, etc. are now in the order stage to meet all necessary requirements.

Moreover a manual, called safety guide, has been distributed, mentioning the danger of the materials used at TSP Complex, how to protect yourself against them, what to do in case of accidents, etc. and rules for fire protection.

Also a manual, called electrical hazard in fertiliser factory, has been distributed as well, because electricity requires different safety precautions than, for instance, sulfuric acid.

C. Good housekeeping within the plants

On the same yellow, pocket size chart for safety precautions are also mentioned the instructions how to maintain good housekeeping within the plants.

These instructions are as follows :

a. Keep the aisles clear of material and equipment.

b. Do not let materials block access to the electric panels, fire equipment or work areas.

c. Keep the floor surfaces clean, in good repair and free of slipping hazards.

d. Keep the work platforms clean and repaired.

e. Clean the rest rooms and fountains regularly.

f. Keep all trench and pit covers in place.

These instructions are essential as these are the basis to create a safe, working condition.

But, if there is a continuous leakage of materials from equipment like towers, elevators, screens, insufficient dust collecting system in which some ducts of more than 10 meters length are installed horizontally, is it a very tough job to maintain these instructions.

Also due to continuous, repairing work, a lot of steel pieces, spares, welding machines are spread all over the plant site to minimize shut-downs as shut-downs are very harmful, especially for sulfuric acid plants, because moisture from the very humid air will be absorbed by the sulfuric acid and the more the sulfuric acid is diluted, the more corrosive the diluted sulfuric acid is .

Actions to be taken to make the employees easier to maintain good housekeeping are :

1. The installation of a granulation plant, at the end of 1982, through which the dust problem will be minimized considerably.

2. The implementation of FIRP, the fertilizer industries rehabilitation programme, at the end of 1983, through which leakages of acids will be zero.

D. Environmental aspects

The environmental aspects at TSP Complex may be related to good housekeeping in connection with the prevention of leakages and spillages of acids and dust.

As mentioned before the installation of a granulation plant will minimized the dust problem and consequently the pollution of the ambient air considerably.

Most of the dust from the TSP in powder form is granulated together and the remaining dust is scrubbed with water in a dust scrubbing system.

Also an advantage of the installation of the granulation plant is, that the fumes which pollute the air in the form of HF, hydrofluoric acid, and SiF4, silicon tetra fluoride, evolved during curing of green TSP, will be minimized, as the green TSP will directly or after maximum 3 days be granulated and the SiF4 and HF evolved during this granulation process will be scrubbed with water in the fume scrubbing system.

The implementation of FIRP in which, among others, the absorption and drying towers will be completely renewed, the acid leakages, which pollute the surface water, will become zero. Also the installation of demisters included in the FIRP will reduce the airpolution of sulfuric acid droplets considerably.

Most of the airpollutions from phosphate fertilizer plants are converted into surface water pollutions, which are easyly to tackle by introducing lime etc. and the environmental pollutions by TSP Complex will be negligible after the installation of the granulation plant and the implementation of FIRP.

A manual regarding environment pollutions, has been made on stencils and distributed to the attendancees during the lecture of this subject.

III TRAINING ACTIVITIES

A. Training manuals

3.01 The first training manuals, see Annex VI.A, which are the basis of the training programme, have been written by the training adviser himself.

3.02 These training manuals are written in the KIS(S) way, the keep it simple way, to make it understandable for everybody by explaining why something has to be done in a certain way. Also the content has been kept as less as possible, knowing that most of the people in the world have a phobia against reading (and writing).

3.03 The subjects of the training manuals are mainly related to activities of TSP Complex , so that what they have learned may be easily recognised during in-plant training. For this reason the training manuals may be used for students, apprentices, local personnel, and others.

3.04 These type of training manuals have been discussed with several officers, who have been trained before, to motivate them and to make them interesting in teaching .All are aware of the importance of training, but teaching gives the difficulties, that they are afraid to make mistakes and not being able to answer all the questions from their audience.

3.05 The officers, who have no problem in teaching, see Annex VI-B became enthusiastic and cooperated in the make of more training manuals and even in the submission of a training manual written by themselves. This cooperation is essential as the method of training of the training adviser is the training of the minds.

3.06 Some of the training manuals have been added with an annex or like the training manual for phosphate rock completely revised. Information collected during the training courses, included the results of the examinations are the reasons for the additions or revisions of the training manuals.

B. Training courses

Most of the training courses are conducted by teaching personnel, who are recruted from the personnel of TSP Complex, who have the capability in teaching, reading and writing. The planning, arranging of curricula, training programmes and schedules, correcting reports etc. are done by the training management, which consist of the training manager, teaching personnel and the training adviser, in close cooperation with the management of the TSP Complex.

The training courses have been held at TSP Complex for the following categories :

1. Officers and Senior Officers

Lectures have been given by the leader of the Japanese team to the officers and senior officers regarding calculations. The subjects were :

a. Mixing of two different concentrations of acid.

b. Quantities of water in concentrated acids.

c. Heat exchangers.

d. Pressure drops in ducts and pipes.

2. Junior Officers and Mid-level Officers

Intensive training during four months have been given to 105 junior-and mid-level officers by the teaching personnel in close co-operation with the training adviser to up-skill their knowledge. After the training course they had to undergo an examination and when they received an unsufficient mark for their examination, they had to undergo the same examination until they got good marks.

It may be mentioned herewith, that this training course was a great success. When 15 officers of this catogory applied for a job in Iraq, and were examined by an Iraqi committee, they passed and got a job, varying from 400 to 500 US-dollars per month included free transportation and free food and lodging.

3. Operators

A training programme have been made to up-skill the operators during 3 months by the teaching personnel, but has been postponed to the period of long shut-down, in which a granulation plant will be installed.

Seven operators joined the 15 junior - and mid-level officers to Iraq, so all hands are now required to keep the plants in full production.

4. Ex - PIC, Plant In Charges

The plant in charges were withdrawn from their duties with immediate effect from 16 August 1982 for re-orientation and intensive technical and management training.

A training programme, see annex VIII, a schedule and a curriculum have been made and issued to the ex - PICs.

They have to prepare a manual themselves in accordance with the instructed subject and, before they give a lecture, same has to be thoroughly discussed with and corrected by the training management.

The lecture given by the ex-PIC are attended by experts of TSP Complex for raising questions, together which the other attendancees, regarding his subject.

For the way of answering the questions and preparing the manual the ex-PIC will get his marks. Unsufficient marks may lead to his dismissal.

5. Trainees from other companies

Trainees from other companies receive an intensive training at TSP Complex by the training management and special attention is given in connection with wasting time, as these courses are mostly on short term basis, one month or less, because the companies have to pay for their training.

Reports have to be made by these trainees and have to be checked by the training management and the results directly transferred to the director of that company.

An example is, the training of supervisors and operators of the private company Monir Chemicals Ltd., Joydeppur, Dhaka, in the manufacture of sulfuric acid.

It should be mentioned herewith, that when the brand new plant of Monir Chemicals Ltd. had to be started-up, about one month, end of August and beginning of September 1982, was only required to run the plant at 110 percent of its nameplate capacity under supervision of 4 start-up engineers of TSP Complex, see Annex X-B.

6. Apprentices

Forty three out of fifty three apprentices remained after one year of training. They were given theoretical lectures during the first half year according to their education grade, see annex IX, and the second half year they were put in shifts.

After the training course, by the personnel of TSP Complex they had to undergo a written examination and those, who did not pass, had also to undergo a verbal examination. All received a training certificate of TSP Complex.

It should be mentioned herewith, that it was a pity that only a few of the apprentices could be absorbed at TSP Complex due to a personnel stop.

Plans will be prepared, that if the apprentices could not be absorbed at TSP Complex, they are good enough to get a job in the Middle East or somewhere else. Discussed with the General Manager of TSP Complex a target of 100 of these trained engineers for the Middle East may be realised, in the coming 2 to 3 years.

7. Students

Students from the BUET, the Bangladesh University of Engineering and Technology in Dhaka, and the Dhaka Polytechnic Institute are regularly trained at TSP Complex for industrial training.

They receive in the morning an explanation and instructions from a teacher regarding a subject, which they have to carry out in a plant or section in the afternoon.

After the course these trainees have to submit a report, for which they get their marks. These marks are sent to their professors and the trainees receive a training certificate.

These students are always welcome as they are the ones who maintain a good relation between TSP Complex, the University and the Institute.

8. Orientation courses

Orientation courses are given to officers, who are transferred from an other enterprise of BCIC to TSP Complex.

They are put in the general shift during a week in a plant or section in which they have to carry out, in the form of a report, the instructions given by the training management.

After having visited the plants and sections and their reports have been corrected, they get a fixed assignement or they are put in the night shifts of those plant or section where their task has been carried out unsatisfactorily.

9. Training courses outside TSP Complex

Persons, who are selected to attend a special course outside the TSP Complex are the best specialist in that subject, as they have to submit after the course a manual to be used as training material for others.

Before the participants are going to attend a course at BUET in Dhaka, or TVA in USA, or a TSP plant in Holland, they receive instructions and guidelines from the training management of TSP Complex, on specific problems, prevailing at TSP Complex, which they have to discuss during the training course and to collect as much as possible information regarding these problems.

C. Fellowships

A very important factor of training is the training abroad, where the fellows are trained in new techniques, advanced technology, etc. and to apply what they learned to TSP Complex.

As mentioned above in B - 9, the fellows are well selected and trained before they are going abroad.

During the stay of the training adviser at TSP Complex, two engineers, see annex X - C have already been trained at IFDC, international Fertiliser Development Centre, in Muscle Shoals, Alabama, USA, from the UNIDO project fund.

After the return of the two engineers, modification of the TVA cone mixture has been executed, saving TSP Complex a lot of money for which reason the training was a great success.

Also 4 engineers of TSP Complex, to undergo a training in Holland in granulation techniques, have been trained and instructed by the training adviser. The training is financed by the Dutch bilateral aid programme and is scheduled to start at the end of the year 1982.

In the near future studytours may be arranged, if budget allows it, by the training adviser with special instructions to collect as much as possible data, know-how, etc., for the benefit of TSP Complex.

IV SPECIAL TRAINING ACTIVITIES

The employees, who have been trained, upskilled, etc., and having a lot of experience, have been given special programmes and training, which they have to execute as a team.

The teammembers have been selected from various departments of TSP Complex, such as laboratory, production, operation etc. From the results of such a team it may be assessed, if the selection of the teammembers is a success.

The teams, which have been already formed or will be formed in the future, are discussed below in details.

A. Trouble shooting teams

As the SA-II, sulfuric acid plant no. II, was occupying to much maintenance personnel, who were doing mainly repair work, the cause could be situated somewhere else, for which reason a team was formed to investigate the operation of this plant.

A team of 4 officiers, see annex X-A has been formed to investigate the operation of SA-II from its first oil firing on 15 July 1974 up till now.

The guidelines which have been followed, were :

a. Study the available log-sheets and log-books.

b. Collect information from the operators.

c. Compare all information with the data supplied by Hitachi Zosen, the supplier of the plant.

d. Analyse the results of the differences and make comments on them.

e. Comments should be based on informations from books, manuals, and other sources, which should be mentioned in the report as references.

f. Recommendations of the team.

g. Make a concised, unit-wise report and put details in annexes.

After the results were known from the report of the team, the operators underwent an examination as a last stage of the investigation on plant operation. It should be mentioned herewith, that the team did a marvellous job, because their investigation was more trouble shooting, so that the operating instruction could be corrected, where necessary, within a short time.

In the future more teams will be formed.

B. Start-up teams

A start-up team of 4 members, of TSP Complex, see annex X-B, have been formed to supervise the start-up of the 10 metric tons per day sulfuric acid plant of the private company Monir Chemicals Ltd. at Joydebpur, Dhaka.

The supervisors and operators of this brand-new plant, supplied by Krebs India, have been intensively trained at TSP Complex when the start-up team arrived in the middle of August 1982.

It should be mentioned herewith, that the start-up team did an excellent job, to start-up the plant within 33 days and to let the plant run at 110 percent of its nameplate capacity, for which the client was very satisfied with this result.

As no more sulfuric acid plants in the country are available in the near future to start-up, the success of this start-up team remains as a high-light in own expertise at TSP Complex and may also be recommended for starting-up sulfuric acid plants in foreign countries.

C. Planning teams

At the moment there exist already a committee, which is taking care of FIRP, the fertilizer industries rehabilitation programme and could be named as a planning team or planning commission as there main task is to realise the FIRP.

The FIRP consist mainly of two parts, one part the execution of a granulation plant at the end of the year 1982 and the second part, the major overhauling of TSP Complex at the end of the year 1983.

To increase the know-how of the planning teams, the following have been done :

1. Granulation plant

The issue of the following drafts :

a. Granulation manual.

b. Process calculation.

c. Equipment specification list included flowsheet.

d. Guidelines on special details to be observed during the training in a TSP plant in Holland.

e. Comments on engineering work supplied by HCG, the Hollandse Constructie Groep, the supplier of the granulation plant.

Just before start-up a lecture will be given on granulation of powder TSP.

2. Major overhauling of TSP Complex

The major overhauling of TSP Complex concerns mainly modifications, replacements of equipment of the sulfuric acid plant no. II, to ensure a smooth operation after the implementation of same.

For the major overhauling of TSP Complex, an offer have been submitted by the Japanese contracter Hitachi Zosen.

This offer, consisting of a commercial and a technical offer, have been discussed and provided with comments by the TSP Complex management in cooperation with the training adviser and have been sent to BCIC headquarters Dhaka for further action.

It is the intension of the training adviser to form in the near future other planning teams, which have to realise the recommendations from for instance the research and development teams.

D. Other teams

The planning in the near future is to create also other type of teams and to train them for the benefit of TSP Complex and the country Bangladesh by utilising their expertise.

The type of teams, which are planned in the near future are :

1. Research and development teams

These teams have to make investigations by calculations, tests on laboratory scale, pilot plant tests, etc. and have to send their recommendation to the planning teams for the realisation of same.

The items or part of the items, which the research and development teams have to investigate are :

a. 100 Percent plant capacities and more.
b. Continuous running of the plants
c. Product quality according to international standards.
d. Economic running plants.

c. Price of products competitive against price of imported products.

A start has already been made, mainly in the form of collecting information from other sources, see chapter I, section F : " Non-related parties".

The information received are discussed more in detail in the chapter V : "OTHER ACTIVITIES".

2. Engineering teams

These teams will be trained to be able to design plants, similar to the plants at TSP Complex.

As TSP fertiliser still has to be imported, plans are being prepared to install a TSP fertiliser plant in Khulna, to abolish the import of TSP fertiliser.

In case that a TSP Plant will be built in Khulna or somewhere else, an engineering team of TSP Complex will be ready to engineer and execute that TSP Plant.

V. OTHER ACTIVITIES

The other activities in the form of advices have been given to :

A. 100 Percent plant capacities and more

As at 80 to 85 percent of nameplate capacities the troubles are mostly due to poor operation, the next step is to increase the capacities to 100 percent. The problems encounterd are completely different than at lower capacity, which are among others :

a. Are the capacities of equipment, units, etc., according to their design capacities ?

b. Are the cooling capacities sufficient ?

c. Have the storages enough capacity ?

The following step is to increase the capacities beyond 100 percent, which is approx. 110 percent and to investigate which equipment, units, etc., limit this increase.

To investigate these capacities, the plants or sections should run for at least 3 days to collect all data required for the investigation.

Efforts have already been started to increase the capacities as follows:

1. Monthly production

The production in MT., metric ton, in the month of September 1982 was :

TSP I : 2165.06 MT green TSP

TSP II : 9705.45 MT green TSP

Total : 11870.51 MT green TSP

This quantity of production in one month has never been shown in the past.

2. Capacity of reaction sections

The reaction sections have shown to have ample capacity, which have been demonstrated on Tuesday 21 September 1982, in MT, metric tons, of green TSP as follows :

TSP I : 188.67 MT (nameplate capacity = 100 MTPD)
TSP II : 669.76 MT (nameplate capacity = 430 MTPD)

Total 858.43 MT green TSP

which has never been shown in the past.
Note : MTPD means metric tons per day.

It has been found, that at these higher capacities the curing house are too small to store all the green TSP for curing.
For the records the dosing capacities are :

TSP I : 3000 MT
TSP II : 3500 MT

The installation of a granulation plant will solve these problems as green TSP may directly, or maximum 3 days of curing, be introduced to the granulation plant.

3. Capacities of other plants and sections

100 Percent and more of the nameplate capacities of the other plants and sections are under investigation and the results sofar are the following :

a. The decrease in capacity of the main air blower of SA-II depends mainly on the increase of pressure drop of the hot gas filter, so a sulfur filter has been ordered to substitute the hot gas filter.

b. The irregation coolers of SA-II have to be cleaned regularly.

c. The slurry-cooler of PA-I has to be redesigned.

B. Continuous running of the plants and sections

To ensure continuous running of the plants and sections, decisions have already been taken to implement, in the near future , the following :

1. Granulation plant

At 100 percent and higher nameplate capacities the curing house is too small, because the green TSP have to be cured for at least 10 days for TSP-II and 3 to 4 weeks for TSP-I.

When the granulation plant will be executed at the end of the year 1982, the green TSP may directly to maximum 3 days of curing be introduced to the granulation plant, for which reason the plants or sections have not to be shut-down due to no place in the curing houses.

2. Import of WPA, wet process phosphoric acid

The import of WPA has the following advantages :

a. In the past the plants and sections have to be shut-down to not in time arrival of elemental sulfur and/or phosphate rock.

The import of WPA, to be stored at plant site, shall compensate the shortage of raw materials due to late arrival of the ships.

b. If for one or another reason, the sulfuric acid plants and/or phosphoric acid plants have to be shut-down the production may be continued due to the availability of the imported WPA.

Information regarding handling and addresses of sellers of WPA have been asked from TVA, Tennessee Valley Authority, Alabama, USA, and the companies Boliden Kemi AB, Halsingberg, Sweden and Supra AB, Landskrona, Sweden, of which the last two are manufacturers of phosphoric acid.

From their information, we are now in contact with Maroc Chemie, Safi, Morocco and its sales office Office Cherifien des Phosphates, Paris, France, regarding WPA.

The sellers of WPA have their own fleet of 10 specially built vessels to carry their own acid and the cost and freight Chittagong per September 1982 is US $ 420.— to US $ 430.— on which 1 percent should be added regarding insurance cost, based on an order of 10,000 metric tons of WPA.

3. Major overhauling of FIRP

The implementation of the major overhauling of TSP Complex, the second part of FIRP, the fertilizer industries rehabilitation programme, in which equipment will be completely renewed, such as the absorbing tower, the drying tower, etc., of SA-II, the sulfuric acid plant no. II, is scheduled at the end of the year 1983.

4. Material of construction

To use the most suitable material of construction to ensure continuous running of the plants, information have been collected from the following companies :

a. Avesta Jernverks A B, Avesta, Sweden, the manufacturer of stainless steel.

b. Berregaard Industries Ltd, Sarpsberg, Norway, a manufactur of Sulfuric acid.

c. Kemira Oy, Helsinki, Finland, a manufacture of sulfuric acid.

d. Tampereen Verkatehdas Oy, Tampere, Finland, a manufacture of filter cloths.

e. Alon Processing Inc., Tarentum, Penna, USA, the process owner of alonizing tubes of heat exchangers in sulfuric acid plants.

C. Product quality according to international standards

As basis to achieve product quality according to international standards, the plants and sections have to run continuously.

These continuously, steady running plants and sections are required to enable the operater to make small adjustments in the process conditions to keep the chemical analysis as well as screen analysis of the product within narrow ranges in accordance with international standards.

Instructions, guidelines, etc., in the form of a training manual will be made in the near future.

Regarding the physical properties of the product such as size, hardness, etc., will be achieved when the granulation plant is in operation.

D. Economic running plants.

To achieve economic running plants the production cost should be lower than the sales price, but at TSP Complex the production cost per metric ton of powder TSP in the last financial years, 1980 - 1981 and 1981-1982, are higher than the sales prices, see Annex XI and Annex XII.

As shown in the annexes the costs of raw materials, i.e. phosphate rock and elemental sulfur, are approx. two third of the operation costs, for which reason much efforts have been taken to reduce these costs.

The steps which have been or will be taken to achieve economic running plants are as follows. :

1. Increase of sales price

The sales price per metric ton of TSP has been increased from Tk. 5000.— to Tk. 5735.—, effective per 1 July 1982.

2. Control of prices of imported raw materials

Although the purchase of raw materials is not done by TSP Complex, the cost prices are checked by TSP Complex and are compared with the information received from TVA.

3. Demurrage

To pay demurrage of US $ 7500.— per day for a ship due to delay in unloading will be eliminated in the near future.

In the major overhauling of the FIRP, the unloading facilities, such as cranes, transfer belt conveyors, scales, are included to renew the old ones, to ensure that the unloading of the raw materials from the ships will not be delayed anymore.

Note : It is also common practice that demurrages are included in the freight -cost.

4. Other items

Other items to reduce the production cost have been taken under consideration as follows :

a. Maintaining good housekeeping, to minimize leakages, spillages, etc.,

b. Controlling and checking expenses or overtime, medical, etc.

c. Checking the right quantity of imported raw materials.

d. Using natural gas from the Bangladesh gas fields, instead of imported oil, for which a gas supply line is now under construction.

e. To make as much as possible use of national products such as rubber belts, links of bucketelevators, etc., for which a close cooperation between TSP Complex and the suppliers exist at the moment.

f. To make use of the expertise of other enterprises of the corporation.

5. Other raw material sources

Raw material from other sources have been investigated as follows:

a. Spent sulfuric acid

Spent acid, containing 70 percent H2SO4 from the DDT factory to manufacture OSP, Ordinary Super Phosphate, and ESP, Enriched Super Phosphate, has been investigated as follows :

1. The make of process calculations

2. Guidlines for operation

3. Guidlines for laboratory tests

4. Laboratory tests.

The results from the laboratory tests were so encouraging that a pilot plant is now under construction.

b. Import of WPA

The import of WPA, wet process phospheric acid, may be ordered at a time that the prices of phosphate rock and/or elemental sulfur are much higher than the import of WPA.

c. Other type of phosphate rocks

Other type of phosphate rocks, which are cheaper than the conventional ones, such as Jordan and Morocco phosphate rocks, have been analysed and investigated at the laboratory of TSP Complex for substitution of the conventional ones.

d. Phosphogypsum

When a phosphogypsum processing plant will be executed at TSP Complex, the import of elemental sulfur may be reduced considerably as the SO2 produced by the processing of phosphogypsum may be used for the manufacturing of H2SO4, sulfuric acid, in the existing sulfuric acid plants.

6. Producing byproducts

To reduce the operation cost, byproducts may be sold as follows :

a. Oleum

In the 100 MTPD, metric ton per day, nameplate capacity sulfuric acid plant no. I, 10 MTPD of oleum is produced.

The attained capacity however is 87 MTPD of H_2SO_4, included 8.7 MTPD of oleum, for which reason the increase in capacity is very important as one metric ton of oleum may be sold for Tk. 6600.— , effective per I July 1982, to the DDT Factory.

b. Gypsum for cement factory

Gypsum from the hemi-dihydrate phospheric acid plant no. II is sold to the cement factory at a rate of Tk. 250.— per metric ton, effective per 1 July 1982.(was Tk. 200.— per MT.)

The requirements of the cement factory in the two last financial years were :

1980-1981	: 5795	metric tons of gypsum
1981-1982	: 11884	metric tons of gypsum

There is a tendency that in the near future more gypsum may be sold to the cement factory.

c. CaO from phosphogypsum

When a phosphogypsum plant will be installed at TSP Complex in the near future, the CaO, a byproduct from the phosphogypsum process, may be sold to the cement factory.

d. Gypsum for agriculture

Gypsum from the dihydrate phospheric acid plant no. I containing approx. 5 percent P_2O_5, may be used as a fertiliser for alkaline soils and may be sold accordingly to the agriculture corporation.

e. Gypsum for glaubersalt manufacture

Tests on laboratory scale have already been made to manufacture glaubersalt, sodium sulfate, from gypsum, but the type of equipment to be used for this process is in the study phase.

$$\underset{\text{gypsum}}{CaSO_4 \cdot 2H_2O} + \underset{\text{soda ash}}{Na_2CO_3} \rightleftharpoons \underset{\text{glaubersalt}}{Na_2SO_4 \cdot 10H_2O} + \underset{\text{chalk precipitated}}{CaCO_3}$$

f. Sulfur

The purity of the sulfur from the sulfur melter of TSP Complex is 99.94 percent S and 0.02 percent organic matter included bitumen.

This sulfur may be sold to the sugarfacteries, which require a pubity of 99.9 to 100 percent S and practical free from bitumen.

After the installation of the sulfur filter in the near future we may have a more pure sulfur , which is more attractive for the sugarfacteries.

E. Price of products competitive against price of imported products

From Green Markets, spot quotations were published, that the FOB prices for Florida phosphate rock per metric tons were :

68 BPL = 31.12 % P205 is US$ 39 to 40

75 BPL = 34.32 % P205 is US $ 45 to 50

The domestic quotation for 68 BPL Florida phosphate rock was listed as US $ 24 to 25 per short ton FOB, which is approx. 31.5 percent lower than the export FOB prices per metric ton.

Due to the low domestic prices, the ROP, run-of-pile, TSP in Florida was listed as US $ 138 to 142 per metric ton in bulk.

The sales price of ROP TSP at TSP Complex is Tk. 5735.— which is, at an exchange rate of 1 US $ = Tk. 21.86, US $ 262.35 per metric ton.

However the farmers in Bangladesh are buying the ROP TSP, per 1 July 1982 for a price of Tk. 110 per maund, fixed by the Government of Bangladesh As 1 Maund = 37.21 kg., the price for ROP TSP is Tk. 2956.19 = US $ 135.23 per metric ton.

So the Government has to subsidize an amount of Tk. 5735.- - Tk. 2956.19 = Tk. 2778.81 plus the difference between operation cost and sales price per metric ton of ROP TSP, if the operation cost is higher than the sales price of Tk. 5735.—

When ROP TSP will be imported, the price, included freight and insurance costs and excluded sales and duty tax, would be US $ 180.— or Tk. 3934.80 per metric ton, so still the Government has to subsidize to induce the farmers to buy ROP TSP.

To minimise the subsidy from the Government and to be competitive to imported products, the following steps have to be done :

1. Economic running plants

The implementation of the steps as mentioned in economic running plants, section D, should be executed first to decrease the operation cost below the sales price.

2. Processing of phosphogypsum

As mentioned before the installation of a plant to process phosphogypsum is essential to have an economic running TSP Complex, to minimize the import of raw materials in this case elemental sulfur, and to reduce the operation costs by selling CaO to the cement factory.

The process is to decompose the CaSO4, calcium sulfate, the byproduct (gypsum) from the phosphoric acid plants as follows :

$CaSO4 + 2C \xrightarrow{700\ ^{\circ}C} CaS + 2CO2$

$2CaSO4 + CaS \xrightarrow{900\ ^{\circ}C} 4\ CaO + 4SO2$

The SO2 released from the decomposition is processed in the existing sulfuric acid plants as follows :

$2\ SO2 + O2 \longrightarrow 2\ SO3$

$2\ SO3 + 2H2O \longrightarrow 2\ H2SO4$

A feasibility study has already been made and has also been approved by the World Bank of the United Nations and the execution of the phosphogypsum processing plant has been included in the 5 year plan of TSP Complex.

3. Other products

The other products which may be manufactured at TSP Complex is based on the availability of ammonia, which will be manufactured in the near future in Chittagong.

Feasibility studies have not been made yet and the following products to be manufactured may be investigated.

a. Ammoniation of TSP

As a granulation plant will be installed at the end of year 1962, the granulation of this plant may be used as an ammoniater- granulator.

b. MAP, monoammonium phosphate

As the manufacture of MAP in powder form requires less recycle than MAP in granular form, a reactor to make MAP under a little overpressure may be added in the granulation plant, as the granulation plant has a low recycle ratio.

ANNEX I

TSP FERTILIZER COMPLEX LTD., CHITTAGONG.

I.01 The TSP Fertilizer Complex Ltd., Chittagong, is the only fertilizer plant in Bangladesh, which produces phosphate fertilizer in the form of powder TSP, so called ROP TSP, Run-of Pile Triple Superphosphate, in comparison with the other fertilizer plants in the country, the 3 Urea fertilizer plants, located in Ghorasal, Fenchuganj and Ashuganj, which produce Urea fertilizer. In the near future two more Urea fertiliser plants will be constructed and will be located at Chittagong, see Index Map of Bangladesh.

I.02 The TSP Complex produces their TSP by two trains, i.e. TSP-I and TSP-II.

Each train consist of the following plants and sections :

a. Sulfuric acid plant
b. Rock grinding and handling section
c. Phospheric acid plant included concentration section
d. Triple superphosphate plant including reaction section, and curing and drying section
e. Bulk and bagging plant.

I.03 TSP - I has been built by the Panamerican Consulting Company Inc., Reistertown, USA and the sub-contracter Technique Chimie Etudes et Services, a consulting chemical engineering firm, Paris, France. The start-up of TSP -I was done in 1967 to 1969 and the commercial production was started in the year 1978, after modifications had been taken place.

I.04 TSP-II has been built by Hitachi Zosen, a Japanese shipbuilding company, and the sub-contracter Nissan Chemical Co., a chemical engineering firm, Tokyo, Japan. TSP-II has been commissioned in the month of July, 1974.

I.05 The nameplate capacities of the plants in MTPT, Metric Ton Per Day, are :

	Nameplate Capacity in MTPD	
	Train I	Train II
Sulfuric acid plant as H2S04	100	400
Phospheric acid plant as P205	32	135
TSP plant	100	430

I.06 The total daily nameplate capacity of both trains see item I.05, is : 530 MT per day of ROP TSP.

I.07 The annual nameplate capacities of the trains are :

TSP -I : 32,000 MT per Year of ROP TSP

TSP-II : 120,000 MT per Year " " "

Total : 152,000 MT per Year of ROP TSP

I.08 The annual production of ROP TSP in the last financial years, which start from the first of July to the first of July of the next year, is :

Year	MT ROP TSP	Percentage of total capacity
1977- 1978	41,270	27.15
1978 - 1979	62,290	40.98
1979- 1980	71,120	46.79
1980 - 1981	71,241	46.87
1981 - 1982	57,888	38,08

I.09 The production during 1981 - 1982 was very low due to shortage of raw materials.

ANNEX II

RANKS AT TSP COMPLEX

MAINTENANCE DEPARTMENT TITLE	OPERATION DEPARTMENT TITLE		DESIGNATION	SALARY SCALE TAKAS/MONTH AUGUST 1982
	ED	Executive Director		2850 (fixed)
	G M	General Manager		2350 - 2750
ACME	ACOM	Additional Chief Operation Manager		2100 - 2600
DCME	DCC	Deputy Chief Chemist		1850 - 2375
ME	C	Chemist		
	Ch. E	Chemical Engineer	Superintendent	1400 - 2225
AME	AC	Assistant Chemist	Shift-in-Charge	750 - 1470
	A.Ch.E	Asstt. Chem. Engineer	Asstt. Suptd.	
SAME	SAC	Sub. Asstt. Chemist	Section-in-Charge	625 - 1315 (after 3 years completion)
	S.A.Ch.E	Sub. Asstt. Chem. Eng.	Foreman	470 - 1135 (initial stage, 3 yrs duration)
MT	MO	Master of Operation		570 - 1018
HST	HSO	High Skilled Operator		480 - 866
ST	SO	Skilled Operator		415 - 729 (grade I) 355 - 555 (grade II)
SST	SSO	Semi Skilled Operator		310 - 470
		Clerk		325 - 610 (senior clerk) 300 - 540 (junior clerk)
ME = Mechanical Engineer T = Technician		Helper		270 - 380 (helper under wages commission) 225 - 315 (helper/cleaner under National Pay Scale, staff)
		Peon	225-315	

ANNEX III
EQUIPMENT LIST as per 30 September 1982
at
TSP FERTILIZER COMPLEX LTD. CHITTAGONG

Qty	Description	Total US Dollars
1	Vehicle : Toyota Hiace/Commuter Twelve Seater	6,700.—
1	Typewriter Olivetti : Linea 98 18"	347.50
1	Air Conditioner Westinghouse A H - I55	429.33
1	Air Conditioner Westinghouse A H - I85	524.—
1	Air Conditioner Westinghouse A H - 185	761.82
1	Carousel Slide Projector, Model 750 H A - R	192.—
2	Chalkboard with Easel	609.—
1	Instructor 2 Filmstrip Projector No. 3972	449.—
1	16 mm Projector No. 2120	1,099.—
1	Motion Picture Screen	141.—
1	Overhead Transparency Maker with Access.	977.—
1	Lien Drafting Machine with Acessories Model GM 7, plus Drafting Stand and Drafting Chair	360.—
1	Photocopier N P - 30	2,768.—
	Total	15,297.65

Except for vehicle, air conditioners, chalkboards, screen, and drafting machine no materials, films, etc., were supplied.

Moreover instruction, operating, and maintenance manuals were not supplied either.

For the reasons mentioned above the equipment are not used at the moment until the materials, manuals etc.,arrive at site.

ANNEX V
BUDGET SUMMARY JANUARY 1981

Item no.	Number req'd	Description	Cost US $
1	1	Canon plain paper copier	3,000.-
2	1	Typewriter	750.-
3	3	Airconditioners	1,800.-
4	3	Drawing machines	3,000.-
5	35	Technical books	2,100.-
6	-	Training materials :	
		Electricity	57,200.-
		Instrumentation	53,140.-
7	1	Air flow simulator	35,800.-
8	1	Liquid flow simulator	37,300.-
		Total	194,090.-

The materials mentioned above have been specified in details and sent to the parties concerned.

During the period of service of the training adviser this budget have been revised some times.

ANNEX VI
BOOKLIST AT END SEPTEMBER 1982

Item no.	Name of book	Author	Price in Danish crowns.
1.	Electric meters	E.P. Andersen/R. Miller	143.72
2.	Switchgear book	R.T. Lythall	487.20
3.	Electrical safety engineering	W. Fordham Cooper	403.20
4.	Home electrics	Geoffrey Burdett	60.78
5.	Question & answer electric meters	A.J. Coker/P. Chapman	47.40
6.	Beginner's guide to electr. wiring	F. Guilleu/C. Gray	63.43
7.	Electrical installation technology	Michael Neidle	140.07
8.	Rewinding small meters	Karl Wilkinson	63.43
9.	Phospheric acid Volume I, part II	A.V. Slack	1168.00
10.	Phospheric acid Volume I, part II	A.V. Slack	1208.00
11.	Fertilizer guide for the tropics and subtropics.	Jan G. de Geus	150.85
12.	The manufacture of sulphuric acid	W.W. Duecker/J.R. West	370.84
13,14.	Training manual for fertiliser plant operator.(one free of charge).	TVA/NFDC	194.15
15,16,17	Fertilizer manual (free of charge)	UNIDO	-
		Total Dn. Crs	4501.07
	(at 1 US$ = 7.75 Dn. Crs)	or US $	580.78

Note : Other books are out of print and substitutes have been ordered at Munksgaard A/S, Copenhagen, Denmark, book company.

ANNEX VII
TRAINING MANUALS

A. Manuals

The training manuals made on stencils for the training center of TSP Complex, Chittagong are :

1. Information about TSP Complex
2. Rock phosphate
3. Sulfuric acid manufacture
4. Phospheric acid manufacture
5. Record on TVA cone mixer
6. Common instrumentation
7. Maintenance and production management
8. High-lights of the maintenance and production management
9. Manufacture of TSP
10. Handling of solids
11. Conveyers
12. Electricity
13. Electrical hazard
14. Safety guide
15. Environmental pollution
16. Corrosion protection for industry
17. 35 Ways to be a better boss.

B. Co-writers

1. Mr. Md. Sadeque, Additional Chief Operation Manager
2. Mr. Kabir Ahmed Choudhury, Additional Chief Electrical Engineer
3. Mr. Fashiur Rahman, Manager Quality Control
4. Mr. S.M. Deb, Mechanical Engineer
5. Mr. Abdul Azis Khan , Assistant Chemist
   Mr. S.C. Chakraberty, Assistant Chemist
   Mr. M.H. Chowdhury, Assistant Chemist.

ANNEX VIII.

TRAINING PROGRAMME FOR
EX -PLANT - IN - CHARGES

A. Lecture

1. Organisation (TSP,BCIC, Government)
2. Disciplines in Industry
3. Cost accounting and cost control
4. Process and Quality Controls (TSP-I, TSP-II)
5. Instrumentation
6. Electricity
7. Maintenance
8. Safety
9. Corrosion
10. Pollution
11. Unit Operations
12. Laboratory
13. Administration
14. Finance
15. Inventory Control
16. Research and Control
17. Sales
18. MPIC, material planning and inventory control

B. Execution of the Training

1. Every Ex-PIC has to prepare himself for a lecture. Topics for the lecture will be issued by the training management.
2. When an Ex-PIC gives a lecture, experts, etc., are attending his lecture and will questioning him.
3. After each lecture the Ex-PIC gets his marks

C. Requirements

Free excess to any department, section etc., to enable the Ex- PIC to collect his data.

ANNEX IX
EDUCATION GRADES

A. Primary/Secondary School

The children start their education with the Primary School, consisting of 5 classes, and follow thereafter 5 classes of the Secondary School in which they specialize themselves in Science, Arts or Commerce.

After passing successfully their examination in the 10th class the scholars receive their certificate. The certificate is the S.S.C the Secondary School Certificate in Science, Arts or Commerce.

Education (Science) :

Mathematics : Arithmetic, Basic Algebra and Geometry.

Physics : Laws of Newton, Archimedes, Boyle, Charles.
Chemistry : Some Organic and Inorganic Chemistry.
English : General Course and Grammar in Secondary School.

For a training course in Grade 1. the minimum educational qualification is SSC (in Science).

B. Higher Secondary School

With the SSC the scholars may attend the Higher Secondary School for further education in their specialization (Science, Arts or Commerce) during 2 schoolyears.

After passing successfully their examination they receive their HSC, the Higher School Certificate in Science, Arts or Commerce.

Education (Science):
Mathematics : Elective Mathematics, Algebra, Trigonometry.

Chemistry : Inorganic, Organic and Physical Chemistry.

English : Compulsory English, Litterature and Grammar.

For a training course in Grade 11. the minimum certificate in HSC in Science

C. University or College

Bacheler of Science

With the HSC the students may attend the University or College for further development of their education. After 2 years of study and passing successfully their examination they get B. Sc. Bacheler of Science certificate in general.

Education :
Mathematics : Differentiation, Intergration.

Physics : Advance Course in Physics, Thermodynamics.
Chemistry : Advance Course in Inorganic and Organic Chemistry.

For a training course in Grade 111. the minimum certificate is B.Sc.

D. Poly-Technical Institute :

Scholars with SSC in Science or HSC in Science may attend the Poly-Technical Institute to specialise themselves in technical course, which takes 3 years of study.

After passing successfully their examination in the 3rd year they receive a diploma in a Technical Course e.g. in Electrical-,Chemical-or Civil-Engineering etc.

They may attend the training course in Grade 11.

E. Engineering University :

With the HSC in Science the students may attend the Engineering University to specialise themselves in Engineering, which takes 4 years of study.

After passing successfully their examination in the 4th year they receive the B.Sc. Eng, the Bacheler of Science certificate in Engineering.

F. Summary of Certificates in Science

Duration Study Years	Certificate in Science	Technical courses
10	SSC (Secondary School Certificate)	Grade I
+2	HSC (Higher Secondary Certificate)	Grade II
+2	B.Sc.(Bachelor of Science Certificate)	Grade III
+2	M.Sc(Master of Science Certificate)	
+3	Diploma in Technical Course	Grade II
+4	B.Sc. Eng. (Bachelor of Science in Engineering)	

ANNEX X
SPECIAL TEAMS/FELLOWSHIPS

A. Trouble shooting teams

The members of the trouble shooting team, who scrutinised the operation of SA - II, were :

Mr. Abu Taher Mohammad Khaled, Deputy Chief Chemist, Team leader.

Mrs. Sufia Begum, Asstt. Chemist

Mr. Abdul Aziz Khan, Asstt. Chemist

Mr. Subash Chandra Chakraborty, Asstt. Chemist.

B. Start-up teams

The members of the start-up team, who started up the sulfuric acid plant of the private company Monir Chemicals Ltd., were :

Mr. Mohammad Sadeque, Additional Chief Operation Manager, Team leader.

Mr. Abu Taher Mohammad Khaled, Deputy Chief Chemist, Supervisor of operation.

Mr. Mong Hla Thewai, Maintenance Superintendent, Supervisor of Maintenance.

Mr. Abu Taher, High Skilled Operator.

C. Fellowships

The engineers of TSP Complex, who have been trained at IFDC, International Fertilizer Development Centre, Muscle Sheals, Alabama, USA, from UNIDO project fund were :

1. Mr. Mohammad Sadeque, Additional Chief Operation Manager, in the month of December 1980.

2. Mr. Swapan May Deb, Mechanical Engineer, in the month of October 1981.

ANNEX XI

PRODUCTION COST FOR 1980-1981

PRODUCTION : 71,241 MT.

Sl. No.	Elements of cost	Unit	Usages Ratio	Total Qnty Consumed	Price per unit of inputs in Tk.	Total cost (in lac Tk.	Cost per M.T. (in Tk.)
A. VARIABLE COST :							
1.	Rock Phosphate	M.T.	1.61	114465	1,496.26	1,712.69	2,404.08
2.	Rock Sulphur	M.T.	0.36	24417	2,187.31	534.08	749.68
3.	Other materials/ Chemicals	—	—	—	—	21.66	30.40
4.	Spares & Accessories	—	—	—	—	96.73	135.78
5.	Electricity (PDB)	KWH	155	11028482	0.99	109.33	153.47
6.	Furance Oil	Gal	2.25	160300	12.74	20.42	28.66
7.	H.S.D. Oil	Gal	0.13	8999	22.67	2.04	2.86
8.	Gunny Bags	No.	25	1782945	9.66	172.26	241.80
9.	Polythene Bags	No.	25	1782945	5.50	98.96	138.91
10.	Others (Sewing thread, Needle & WASA Water)	—	—	—	—	0.95	1.33
11.	Overhead	—	—	—	—	6.36	8.93
	TOTAL VARIABLE COST :-					2,775.48	3,895.90
B. Fixed Cost :							
1.	Wages & Salaries	—	—	—	—	165.60	232.45
2.	Depreciation	—	—	—	—	* 46.57	65.37
3.	INTEREST :						
a)	Interest on loan (BCIC)	—	—	—	—	232.90	326.92
b)	Interest on ADP loan	—	—	—	—	88.93	124.83
4.	OTHER OVERHEAD :						
a)	Insurance premium	—	—	—	—	7.10	9.97
b)	Other adm. overhead	—	—	—	—	133.66	187.62
c)	Other factory overhead	—	—	—	—	100.28	140.76
d)	Other selling & distribution overhead	—	—	—	—	2.02	2.84
	TOTAL FIXED COST :-					777.06	1,090.76
	TOTAL COST OF PRODUCTION (A+B)					3,352.54	4,986.66

* Total Depr. for 1980-81 = 2,98,87,846.17 - 2,52,30,383.40 = 46.57,462.77
(minus adjustment in respect of 1979-80 and previous years.)

Sales price = Tk. 4350 per MT of ROP TSP

1 US$ = Tk. [illegible] 19.95

ANNEX XII
PRODUCTION COST FOR 1981-1982
PRODUCTION : 57,888 MT.

Elements of Costs	Unit	Usage Ratio	Total qnty. consumed	Price per unit of input (in Tk.)	Total cost (in lac Taka)	Cost per M T. of TSP (in Taka)
A. VARIABLE COST :						
1. Raw Materials :						
a) Rock Sulphur *	MT	0.36	24230	3573.54	865.87	1363.99
b) Rock Phosphate *	MT	1.67	100770	1730.22	1747.74	2996.53
					2,613.61	4,360.52
2. Chemicals	Let	—	—	—	20.36	35.17
3. Packing Materials	Let	—	—	—	164.23	283.70
4. Fuel/Gas	Gal.	—	—	—	30.09	51.98
5. Power	KWH	—	—	—	101.76	175.79
6. Spares & Accessories (including overhauling)		—	—	—	215.74	372.68
7. Factory overhead		—	—	—	21.09	36.43
8. Selling & Distribution overhead		—	—	—	2.34	4.04
9. Head Office levy		—	—	—	15.45	26.68
Total Variable Cost :-					3,184.67	5,346.99
B. FIXED COST :-						
1. Salaries & Allowances		—	—	—	151.65	261.97
2. Factory overhead		—	—	—	30.99	53.53
3. Administrative overhead		—	—	—	106.59	184.13
4. Insurance Premium		—	—	—	6.40	11.05
5. Depreciation		—	—	—	-	-
6. Interest & Financial charges		—	—	—	168.71	291.44
7. Selling & Distribution Exp.		—	—	—	0.27	0.47
Total Fixed Cost :					464.61	802.59
Less :- Adjustment for In-process Stock :					(-) 62.93	(-) 108.71
Cost of Production :-					3,586.35	6,040.87
Less for the year					453.96	

Sales price : upto Nov'81 =Tk 4,350/- ; from Dec'81 to June'82 =Tk 5,000/- per MT. 1 US$ = Tk 20.00

* Total quantity & value for sulphur & phosphate is for TSP as well as for other intermediary products but cost per ton against these are for TSP only.