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SYRIAN ARAB REPUBLIC

Technical report: Improvement of maintenance and operational practices in the cement industry. Preliminary assessment of the general situation at the cement plants of the ADRA CEMENT CO. and the TARTOUS CEMENT CO.*

Prepared for the Government of the Syrian Arab Republic
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

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Based on the work of H.H. Brandt, cement plant expert

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* Mention of company names and commercial products does not imply the endorsement of UNIDO. This document has not been edited.

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ABSTRACT

Purpose of Project:	The project is aiming at laying the foundation for an upgrading of maintenance and operational routines in different branches of cement industry including manufacture of asbestos-cement products.
Post Title:	Cement Plant Expert (Maintenance).
Number:	DP/SYR/86/009/11-01/Rev.1
Objectives:	Preliminary assesment of the general situation at the cement plants. Formulate programmes and methodologies for solving technical problems and improving productivity with emphasis on maintenance.
Duration:	Four months total, in split-missions.
Main Conclusion and Recommendations:	ADRA. Problems of management at the ADRA Cement Co. is hampering the efficient utilization of a relatively new (5 - 10 years) and modern cement plant. The low production out-put (50% of capacity) and a very low work spirit is caused by the lack of basic management practices for general administration, production planning, preventive maintenance and materials control. It is recommended to strengthen the management of the ADRA Cement Co. by a clearification of the personnel organization incl. well defined job descriptions and responsibilities, and by the introduction of systems for production control, maintenance, stores and purchase control, and by personnel training. TARTOUS In spite of good management effords at the TARTOUS Cement Co., it has not been possible to reach the nominated production capacity of 2,000,000 t ce-

ment per year. This capacity is based on the production of 1,600 t/24h cement clinker by each of the four kilns installed at the plant.
Due to the inhomogenious quality of lime stone and jamming of the lime stone in the storage silos it has not been possible to obtain the nominated daily clinker production capacity. Only the production of 1,000 t/24h (max. 1,4000 t/24h) have been obtained by each kiln.
A study should be performed by consulting experts, to find efficient and low cost solutions concerning the supply of homogenious crushed limestone for the rawmills at TARTOUS.
Due to a general shortage of spareparts and consumables such as grinding media and refractories, the maintenance and the production at the cement plant is performed at high production costs and low production out-put.
A priority list of minimum import requirements concerning spareparts and consumables should be worked out every 6 months by the plant management.
Funds should be allocated immediately for purchases in accordance to the list.
Specialist assistance should be called soonest from the original suppliers or a consultant engineer to perform condition checks and adjustments of each kiln in turn.
Systems for preventive maintenance should be introduced at the plant.
Effords should be intensified to increase export of cement and clinker from TARTOUS.

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INTRODUCTION

By four visits of total four months during 1988 and 1989 two of the eight Syrian cement plants were visited by Mr. H.-H. Brandt, UNIDO- expert for cement plants.

The visits were planned by the General Organization for Cement Industry, G.O.C. in Damascus as part of a four months split-mission concerning technical advisory service to the Syrian cement industry, UNIDO post no. DP/SYR/86/009/11-01.

The purpose of the visits to the cement plants was to make a preliminary assessment of the situation at the plants in general and to analyse shortcommings in the maintenance and the operation of the plants, as well as to advice on corrective measures with the plant management and local experts.

It is the intention by this report to provide an objective general description of the actual situation at the two Syrian cement plants, which were visited during the mission. Based on the observations made by the expert, some important measures are recommended by the report for urgent needed improvements at the production and maintenance at the cement plants.

I would like to express my sincere thanks to all officials and individuals met, for the kind support and valuable information which was received during the mission and which highly facilitated the work for the project.

RECOMMENDATIONS

For the ADRA Cement Co. the following recommendations have been made:

1. It is recommended that clear plans of the complete organization of the ADRA Cement Co. are prepared, confirmed and distributed to all heads of departments together with job descriptions for all positions at all levels in the organization.

It should be the duty and the responsibility of the general director that this work is completed soonest possible in joint cooperation with heads of departments, and by the support of GOC and if necessary by the assistance of a consultant.

2. It is recommended that action is taken soonest possible to introduce simple and efficient control systems for preventive maintenance. The systems must ensure that efficient lubrication, inspection and condition checking of the plant machinery is performed at regular intervals. The introduction of a PM-system at the plant may require a temporary assistance from a consulting engineer.

"Stop-lists" for the preparation, coordination and timing of all repairs during kiln stops should be introduced as part of the preventive maintenance work.

3. It is recommended that a training manager is appointed. The training manager should be a qualified engineer with some experience from the cement industry, or should be a teacher with some technical and administrative experience from the cement industry. The training manager should be responsible for the commisioning of the training centre at ADRA. This should comprise a limited preliminary use of the existing facilities for short and efficient training programmes, aiming to improve maintenance and operation of the ADRA cement plant. During the first year the training programmes should only concern the personnel of ADRA, but later the training should also be offered to personnel from other cement companies.

For the TARTOUS Cement Co. the following general recommendations have been made:

1. It is recommended that a feasibility study is performed by consulting experts to analyse the problems and needs concerning constant feed of homogenious quality of raw materials for the raw mills. The feasibility report should analyse alternative

solutions to the present problems, and should recommend efficient, low cost methodes to eliminate or reduse the problems.

2. It is recommended that condition checks and adjustments incl. some repairs are performed for each of the four kilns. This work should comprise measurements and adjustments of the kiln alignments, inclinations and position of support rollers, live ring movements, kiln shell deformations etc. A report for each kiln with all measurements, findings and recommendations should be prepared and discussed with the management and GOC. The kiln checking and the reports should be made by an expert assisted by engineers from the plant, and opportunity should be taken to train one or two of the engineers in kiln maintenance.

3. It is recommended that systems for preventive maintenance (PM-systems) are introduced at the plant for proper maintenance of the cement producing machinery and equipment. The PM-systems should be simple manually operated systems, which should be gradually developed and introduced at the plant, with priority to the most important machinery and equipment. By some guidance from an expert the systems could be developed by a group of engineers from the cement company.

GENERAL CONCLUSION

During the visits in 1988-89 at the cement plants of ADRA amd TARTOUS many technical and administrative problems were observed and discussed with the engineers and management of the two cement plants and that of G.O.C.

The plants which are large dry process cement plants have been manufactured and supplied by SKET/VEB of DDR in the years from 1978 to 1983. Due to general administrative and management problems at the cement plants the cement producing machinery has been exposed to heavy wear and damage which now is the major cause of the low production efficiency.

It can be concluded in general that improvements of maintenance and operational practices can be achieved at the two cement plants, by the following basic changes:

-A reshape of the plant organization to improve the delegation of responsabilities and flow of information.

-Training of personnel at all levels to achieve a better understanding of work tasks and increase of work spirit. This could be started by the provision of essential technical literature for the engineers, e.g. by a technical library at each cement plant.

-Introduction of preventive maintenance and proper operation control in particularly for the rotary kilns.

-Strict control of minimum requirements concerning spare-parts and consumables. Especially for the items which must be imported.

Only by major effords and change of work spirit can the proposed improvements be achieved.

Attachment I

Preliminary assessment of the general situation at the Cement Plant of ADRA CEMENT CO.

The following abbreviations have been used in this document:

US $	United States Dollar (Nov. 1988)
LS	Syrian Pount at the exchange rate (Nov. 1988), one US $ = 11.00 LS
UNIDO	United Nations Industrial Development Organization (Vienna)
UNDP	United Nations Development Programme (New York)
GOC	General Organization for Cement and Building Materials (Damascus)
ADRA	Adra Cement Company
DDR	German Democratic Republic
SKET	SKET veb. Zementanlagenbau, Dessau, DDR
t	Metric ton = 1,000 kg
t/h	Metric ton per hour
kW	Kilowatt
V	Volt
rpm	Revolutions per minute
km	Kilometre = 1,000 metres
PM	Preventive Maintenance

Kiln support No. I
Kiln support near burner platform

ABSTRACT

Purpose of Project:	The project is aiming at laying the foundation for an upgrading of maintenance and operational routines in different branches of cement industry including manufacture of asbestos-cement products.
Post Title:	Cement Plant Expert (Maintenance)
Number:	DP/SYR/86/009/11-01/Rev.1
Objectives:	Preliminary assessment of the general situation at the cement plant of ADRA Cement Co. Formulating programmes and methodologies for solving technical problems and improving productivity with emphasis on maintenance, storekeeping and procurement of spareparts, safety and training of personnel.
Duration:	One month.
Main Conclusion and recommendations:	Problems of management at the ADRA Cement Co. is hampering the efficient utilization of a relatively new (5 - 10 years) and modern cementplant. The low production output (50 % of capacity) and a very low work spirit is caused by the lack of basic management practices for general administration, production planning, preventive maintenance and materials control. It is recommended to strengthen the management of the ADRA Cement Co. by a clearification of the personnel organization incl. well defined job descriptions and responsibilities, and by the introduction of systems for production control, maintenance, stores and purchase control, and by personnel training.

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APPENDIXES

INTRODUCTION

During the time from 07.11.88 to 30.11.88 the ADRA Cement Co. of Syria was visited by mr. H-H. Brandt, UNIDO-expert for cement plants.

The visit was planned by the General Oganization for Cement Industry, GOC, in Damascus as part of a four months split-mission concerning technical advisory service to the Syrian cement industry, UNIDO post DP/SYR/86/009/11-01.

The purpose of the visit to the ADRA Cement Co. was to make a preliminary assessment of the situation in the plant in general and to analyse shortcommings in maintenance and operational routines in particular, as well as to engage in corrective activities in co-operation with the plant management and local experts.

Previous technical reports concerning the ADRA Cement Co. have been prepared by the following consulting engineering companies:

1- August 1985 on behalf of GOC.
Prospective Engineering Gestion P.E.G. Switzerland.
Titel: ADRA II , Expert report on plant operation and observed problems.

2- January 1986 on behalf of ADRA Cement Co.
Christian PFEIFFER Machinenfabrik. W.Germany.
Titel: Cement guiding plants performance CM1, 2 and 3.

3- October 1987 On behalf of the World Bank.
HOLDERBANK, Management and Consulting Ltd.,Switzerland.
Titel: Energy efficiency study for the cement industry of the Syrian A.R.

It is the intention by this report to provide an objective general description of the actual situation at the ADRA cement plant. And to recommend some realistic measures for urgent required improvements of the general administration and the control of production, maintenance and materials.

The programme of the mission is shown by appendix no.1, and a list of the persons met during the mission is shown by appendix no.2.

RECOMMENDATIONS

1. It is recommended that clear plans of the complete organization of the ADRA Cement Co. are prepared, confirmed and distributed to all heads of departments together with job descriptions for all positions at all levels in the organization.

It should be the duty and the responsibility of the general director that this work is completed soonest possible in joint cooperation with heads of departments, and by the support of GOC and if necessary by the assistance of a consultant.

2. It is recommended that a production manager is appointed. The production manager must be a qualified chemical engineer who should have at least three years of experience as production engineer of a dry-process cement plant or similar industry.

3. It is recommended that the technical director and the production manager take actions as follows for immediate improvement of process and production control:

- Start repair and maintenance of all the necessary instruments and electronic control systems of the production lines.
- Issue instructions and guidelines for the correct production control in each section of the production department.
- Ensure that correct production records are proper reported, circulated and filed.

4. It is recommended that the technical director takes action to introduce simple but efficient control systems for preventive maintenance. The systems must ensure that efficient lubrication, inspection and condition checking of the plant machinery is performed at regular intervals. The introduction of a PM-system at the plant may require a temporary assistance from a consulting engineer.

'Stop-lists' for the preparation, coordination and timing of all repairs during kiln stops should be introduced as part of the preventive maintenance work.

5. It is recommended that a stores manager is appointed. The stores manager should be a qualified engineer or should have a commercial education specialised in stores management. The stores manager should speak and read English and preferably German. A job description for the stores manager is shown as example by appendix no. 10.

6. It is recommended that the general director and the stores manager take action to introduce simple manual stores control systems including procurement control systems.

7. It is recommended to reduce the high costs of production and improve the productivity of the employees by redusing the number of employed personnel. The present number of employees is 1.606, which is approximately three times the normal rate of employment for cement plants at the same type and capacity as ADRA. The reduction of personnel could be achieved gradually by normal reductions due to age and reteirement of personnel etc. It is also recommended that the number of work-shifts is changed to six or eight shifts. This would reduse the number of workers at duty, hence improve the management and the efficiency of the personnel.

8. It is recommended that a training manager is appointed. The training manager should be a qualified engineer with some experience from the cement industry, or should be a teacher with some technical and administrative experience from the cement industry.

9. The training manager should be responsible for the commissioning of the training centre at ADRA. This should comprise a limited preliminary use of the existing facilities for short and efficient training programmes, aiming to improve maintenance and operation of the ADRA cement plant. During the first year the training programmes should only concern the personnel of ADRA, but later the training should also be offered to personnel from other cement companies.

I. GENERAL FEATURES OF THE PLANT.

The ADRA cement plant is situated 30 km North-East of Damascus in a wide spaced area developed for industry. The plant has excellent connections to the national highway system and the railroads.

The first cement production by the ADRA Cement Co. was started in 1978 after the installation of ADRA- I which comprise of two production lines, each for the production of 1000 t/day cement by dry process. In 1983 the production capacity was increased by one extra production line of 1000t/day, named ADRA II. The kilns and the mills of the three production lines are identical.

A plant lay-out and a list of major machinery and installations in the cement plant is shown by appendix no.3 and no.4 respectively.

The ADRA Cement Co. is owned 100% by the Syrian Arab Republic and is controlled by the Ministry of Industry and by the General Organization for Cement and Building Materials, GOC.

The plant was supplied by SKET of Dessau, DDR, and the consulting engineering company responsible for the projects was D.C.I.L. of Calcutta, India. Although the ADRA- II was commissioned in 1983 some technical points still remain to be solved before a complete takeover can be accepted by the cement company. The chief engineer from SKET is for this reason still 'on site' more than five years after the commisioning.

The rawmaterials for the cement production at ADRA are considered to be rich in quality and quantity, however proper and thorough investigations of the rawmaterial deposits have never been exersized. The rawmaterials which are all quarried 2-3 km from the plant are:

	Raw mix composition
Limestone	50 - 60 %
Marl	27 - 36 %
Bazalt	11 - 14 %

At the cement mills 3% gypsum and 6% pozzolana is mixed with the clinker, both materials from local deposits.

Only one type of cement is produced by the ADRA Cement Co. namely ordinary portland cement of strength grade 450 kg/cm2. All cement dispatch is by road either packed in 50 kg bags or in bulk. During 1987 the company produced in total 601,575 t cement of which 48,629 t was exported to Lebanon and Saudi Arabia

II. CONDITION OF PLANT MACHINERY

A. Plant in general

The installed plant machinery is in general not very sophisticated in design and should as such not provide major difficulties in service and maintenance. It is however the experience that the daily production rates can not be forced to more than 80% of the installed capacity due to insufficient feed controls for mills and kilns, variations in raw mix composition and insufficient control of kiln burners.

During the first years of operation a number of serious break downs occured, such as cracks in mill heads and mill bodies, cracks through a kiln tyre and damaged gear wheels of mill main gears. The reasons for these breakdowns are supposed to be found in the design and the manufacture of the machinery.

Time did not permit a detailed and thorough condition check of all plant machinery. However, the following observations and recommendations were made:

B. Instrumentation and electronic equipment

Many of the instruments and the electronic installations throughout the plant are not functioning due to lack of spareparts or proper maintenance. Almost all curvewriters at the mills and the kilns control panels are out of function and without paper. This has a serious influence on the process control which results in inefficient production and risk of further damage of the machinery.

Whithout curvewriters the production management can only depend on the daily production reports which are showing the hourly readings for some of the instruments. This does not provide a reliable production control, especially for the night shifts and in consideration of the condition of the instruments.

C. Main gears for mills

The mill drives at ADRA- I consist of main gear boxes for central mill drive with two high speed reducers and two main motors in parallel. The motors are of 1,120 kW, 6,000 V, 990 rpm from ASEA, and the gearboxes are manufactured by VEB Machinenfabrik of DDR.

This design has been the cause of many break-downs on the mill drives, resulting in major repairs and consumption of expensive spareparts. Major break-downs and operation problems

were experienced at the time of the mission on both raw mill drives at ADRA II.

It is recommended that a specialist from the manufacturers is requested to visit the plant soonest possible for thorough inspections and service of all mill main drives. A report with his findings and recommendations must be submitted from the manufacturers. Visits every year or second year by a specialist for condition checks of the mill drives should be considered.

D. Kilns

The alignment of each kiln appears to be satisfactory and the wear of tyres and support rollers is well acceptable. Minor pitting and some cracks were observed on the surface of some of the rollers, and to avoid further development of this wear it is recommended to keep the surfaces of rollers and tyres at all kiln supports clean of water and oil. The water cooling of the roller surfaces should be stopped gradually and during careful observation to avoid changes in the axial kiln trust. The cooling of the roller bearings must be maintained. As lubrication of the roller surfaces is desirable, only lubrication by graphite should be utilized. A sketch concerning graphite lubrication of kiln rollers is shown by appendix no. 5.

The wear of some of the kiln support rollers and of the trust rollers indicates that minor adjustments of some support rollers are required to obtain a better balance of the kilns axial trust. It should also be considered to correct some of the roller surfaces by a lathe.

The live ring clearance on support no. I at kiln no. III has been too large. This results in large kiln shell ovalities which reduces the service time of the brick linings. A correct live ring clearance towards the live ring support plates should be 0.5 - 3.0 mm., measured when the kiln is in normal operation. This measurement is best found by measuring the relative movement of the tyre in relation to a fixed point of the kiln circumfrence, drawn at the top of the live ring support plates. The measurement must be taken for one turn of the kiln during normal (hot) kiln operation. The live ring clearance is found when dividing the measured relative movement by 2.

The clearance of live ring no. I at kiln no. III was adjusted during November -88 when the kiln was stopped for brick lining repairs. This adjustment was made by the replacement of the tyre support plates, and the new plates were fixed to the kiln shell by weldings as the original plates had been welded to the kiln. It is, however, the experience that the weldings of the plates are cracking after a short time due to the difference in heat expansions of the kiln shell and the support plates. To avoid repeated crackings and weldings, and to permit quicker future adjustments by shimming of the support plates it is recommended to fix the support plates by bolts through the

kiln shell. A correct design and fixation of live ring support plates with guide rings is shown by the sketch at appendix no. 6.

III. PRODUCTION CONTROL

The annual cement production at ADRA has steadily declined during the last three years from 792,050 t in 1985 to 610,575 t in 1987, and the total cement production for the year 1988 is not expected to exceed 500,000 t, or 50% of the rated plant capacity. The production records for the years 1978 - 88 are shown by appendix no. 7.

The reason for the decreasing cement production is not only due to maintenance problems and shortage of spareparts. The weak management and organization of the production department is also to a large extend contributing to the low production. It appears that the cement plant has been without a production manager during a long time, and the process and the production has been controlled by the chiefs of each production section, i.e. crushers, mill, kilns etc. The chiefs of each production section have been reporting directly to the technical director of the plant without sufficient coordination.

It is recommended that a production manager is appointed as soon as possible. This must be a qualified chemical engineer with at least five years experience as production engineer of a dry process cement plant. The new production manager shall be responsible for all sections of the production including quarries and the laboratories.

Immediately after his appointment the new production manager should attend to the following most urgent tasks:

- Reshaping and clearifying the organization of the production department.
- Issuing instructions and guidelines for the correct production control in each section of the production line.
- Demand by requisition lists the repairs of all important instruments and control equipment for the process control.
- Ensure that correct production records are properly reported, circulated and filed.
- Ensure proper communication within the production department, and that all information concerning the production and the quality control is available to management correctly and in time.
- Ensure continual training of the production personnel.

IV. MAINTENANCE

A. Break-down maintenance

Very little preventive maintenance, if any at all, is performed at the ADRA cement plant. A lot of break-down maintenance is continuously ongoing, and major repairs like replacement of gear wheels in main gears or replacement of mill bearings are considered as common work routines. The personnel of the mechanical department appears to work hard and with self confidence on the repairs, and is often achieving successful results in short time.

However this work method is neither very economic nor efficient but results in a high rate of unpredictable production stops by breakdowns requiring a large amount of expensive spareparts. If preventive maintenance was introduced many of the break-downs could be avoided and repairs or adjustments could be made before major damages occured.

B. Cleaning

The preventive maintenance of a cement plant begins by cleaning. The machinery and equipment must be kept clean of spillage from the production line, dust and dirt accumulation in general. Each section chief, e.g. mill foreman and packing plant foreman, must be responsible for the daily cleaning of his area, and the maintenance personnel must not consider a repair job completed until all tools and old parts (scrap) have been removed from the work area.

The technical management should facilitate proper cleaning of the plant by appointing a special work group of 10 - 15 workers/cleaners with a competent, hardworking foreman that will take care of major cleaning in the plant such as large spillage of raw meal, cement or old brick linings from the kilns. This cleaning group should be provided with the equipment necessary, comprising one front-end loader, one tractor and trailer, some dust bins, shovels and wheel-barrows.

The technical management should also specify a closed area where all dust, dirt and scrap from the cement plant can be dumped. An old abandoned quarry area, e.g. at the marl quarry, could be suitable.

C. Maintenance during stops

Preparation of maintenance during stops is the responsibility of the chief engineer or the technical director. When a major part of the plant, e.g. a mill or a kiln, is stopped for

more than a few hours a work programme with a check list for the required maintenance should be prepared. The check list, often called a 'stop-list', must include all the standard maintenance checks and adjustments normally required during stops which are specified in the suppliers manuals. The stop-list must also include checks and repairs which have been found necessary and marked for the stop-list during the time the machine was in operation. A complete stop-list for the particular machine or process department related to the particular stop period must be prepared in cooperation between the production department and the maintenance department. The final prepared stoplist must be distributed in copies to all parties involved with marking of responsibility and time of completion for each task on the list. The stop-list must be available shortly after the stop and should be discussed at meetings for the technical department at the beginning and the end of the stop.

D. Lubrication

The daily maintenance routines such as lubrication of the running machinery is normally the responsibility of the production personnel. The regular checking of lubricants and major lubrication services such as oil replacements must be performed by a special service section of the maintenance department. It is the responsibility of the lubrication section that all machinery of the plant is lubricated with the correct lubricant as specified by the suppliers manuals, that lubricants are kept clean and that replacements are done correctly at the planned intervals. Records of all lubricants and lubrication services must be kept at the lubrication section.

E. Preventive maintenance control

It is recommended that a manually controlled system for preventive maintenance (PM) is introduced at the cement plant. The PM-system must ensure that effective lubrication, inspection and condition-checking of the plant machinery is performed at planned intervals. The PM-system should be restricted to the following parts:

- Machinery installation list for the plant.
- Main register of manuals, drawings etc. for suppliers.
- Files for PM-cards (programme memory).
- Job requisitions.
- Machine data cards.

The facilities necessary for the PM-system consist of a planning office with sufficient space and possibilities for filing the documentation suggested above. The planning office

should also have a writing desk, typewriter and photocopy machine with a stock of stationary.

If correctly adapted and continuously updated the PM-system will keep maintenance costs at their most economical level, and thereby contribute to a reduction of the overall costs of the cement production.

F. Workshops and tools

The mechanical workshops at ADRA are very large in space with a total area of 4,320 m2. The workshops are well equipped with machines for repairs and manufacture of spareparts. A list of the installed machines is shown by enclosure no. 12.

The toolrooms which are attached to the mechanical workshops are of ample size, but the presence of tools is negligible. Only a few wrenches, jacks and a small amount of consumables were found. The small availability of tools and consumables for the workshops is seriously hampering all maintenance work.

During the mission a repair of a cement mill bearing required that the mill trunion surface was polished by fine emery paper. However only course emery paper was available, and the surface of the trunion could not be sufficiently polished which resulted in a new repair of the same bearing a few days later. Needless to say that the cost of the second repair in spareparts and production loss was much more expensive than a few sheets of fine emery paper.

It is recommended that a minimum of necessary tools and consumables is made available for proper maintenance of the plant.

V. ADMINISTRATION

The administration of the Adra Cement Co. is suffering , like the maintenance of the plant, from insufficient regular control functions and plan of administration. The distribution of responsibilies in the organization is weak, and no regular schedule concerning flow of communication or meetings is followed.

The base of an efficient administration is a clear plan of organization with well defined functions and responibilities (See chapter VII). It is recommended that the organization of the company is strengthened by the introduction of the following measures:

- Plan of communication i.e. guidelines for paperflow and reports.
- Fixed meeting plan.
- Reorganization of sections and offices.

It is understood that the financial situation of the ADRA Cement Co. is stressed and that funds for purchase of consumables and spareparts are small. This is why consumables such as ink for the telex machine and refractories for the kilns are not always available when needed.

The lack of spareparts and consumables has a very negative influence on the production efficiency, the maintenance, the workingspirit and above all the economy of the cement company. It is like a bad ring of negative influences and results, which can only be broken by a strong management utilizing a strict budget planning for sale of cement and purchase of consumables incl. spareparts, combined with an efficient production and maintenance control.

An increase of production and export of cement is the only sound solution for the ADRA Cement Co. to recover from the present situation, and the stop of a kiln during nearly 6 months due to shortage of refractories, such as experienced this year, should never again be permitted.

The cost of production must be carefully analysed and controlled by the management to ensure that a profit by production can be maintained. It was not possible during the mission to obtain a clear record of the production costs, but the following information was obtained from the accounts department:

- The official cement price incl. tax.....800.- LS
- Payment to ADRA by the national destrib. board OMRAN.....455.- LS

According to the annual accounts for 1987 made by accounts department at ADRA, the cost of cement production was 398.- LS/t cement, and the costs were devided as follows:

26.15 %	Labour salaries		
58.77 %	Consumables:	Fuel	27.86 %
		Electricity	11.46 %
		Spareparts	3.00 %
		Others	16.45 %
0.71 %	Services. Insurances. Cars, etc.		
14.37 %	Repayment of loans. Depreciation.		

Based on information collected during the mission a cost estimate for 1988 has been calculated. A table for the estimate is shown by appendix no. 8. The total costs of cement production found by this estimate, incl. variable and fixed costs

are 481.82 LS. The cost estimate is based on the present price level for consumables and on the production of 1988 which is expected to be approximately 500,000 t cement.

It appears from the cost estimate that the costs of production during 1988 are exceeding the actual payment received at ADRA for one ton of cement by 26.82 LS. On yearly basis this amounts to a deficit for 1988 of approximately 13,410,000 LS.

If the estimated costs of cement production for ADRA (see appendix no. 8) are compared to the average costs of cement production in developing countries, it will be noticed that the variable costs (28.25 US$) are within the normal range of production costs, while the total costs of production at ADRA are above normal. The reason for the high costs of production at ADRA is the very high labour costs (salaries).

The high labour costs at ADRA are caused by the high rate of employment. Presently 1,606 employees are working for the ADRA Cement Co. The normal amount of personnel employed in other cement plants of same capacity and condition as ADRA is less than 50 % of the employments at ADRA.

It is recommended that the number of employments is reduced gradually but within 1-2 years by 25-50 %. This will not only decrease the costs of production but will without doubt increase the working spirit and efficiency among the employees.

VI. SPAREPARTS

The main store building of 3,456 m2 is very large and adequate for the storing of all mechanical and electrical spareparts. A fenced store yard of 2,880 m2 is situated along one side of the main store building. Other store buildings, halls and store yards are situated in various areas of the plant. In this category a building of 3,300 m2 is presently used for brick storing and for some spareparts belonging to SKET. Also a very large fenced store yard outside the plant contains a surprisingly large amount of equipment, spareparts and consumables which will never be required for the operation of the cement plant.

Lack of proper spareparts and consumables such as kiln refractories, mill linings and grinding media is one of the major disadvantages hampering the production and the maintenance at ADRA. Insufficient registration and weak management of consumptions, stocks and purchase is causing exstra inconvenience to the difficult situation of the cement company.

It is recommended that a stores manager (materials manager) is appointed soonest possible at ADRA. The stores manager should be a qualified engineer or should have a commersial educatiom preferably specialised in stores management and purchase

control. He should speak and read English well and preferably have some knowledge of the German language. A job description for the stores manager (materials manager) is shown as example by appendix no. 10.

Some of the most urgent tasks the new stores manager should attend to immediately after his appointment are the following:

- Reorganize and coordinate personnel and all activities at the stores department.
- Develop and introduce simple manual operated stores control systems including procurement control functions. The proper operation of a stores control system must ensure that stability and protection is achieved for the production, the maintenance and the finances of the company.
- Perform a complete and detailed stock taking of all spareparts and consumables belonging to the company.
- Prepare a list of urgent required spareparts and consumables, each item with a budget price.

The reorganization of the stores department and the introduction of a proper stores control system may require temporary assistance at the plant from a consultant.

VII. PERSONNEL

The total number of employees at the ADRA Cement Co. is approximately 1,606 including management, staff and workers. The distribution of personnel in the various categories is as follows:

Directors/managers	7
Administrative	172
Engineers	43
Supervisors and skilled workers	743
Unskilled workers	633
Casual labour	8
Total number of employees	1,606

(Proper lists of personnel do not exist at the personnel department).

The number of employees is large when compared to the production of the plant, the type of plant and the age of the plant. The high employment rate and the low production efficiency is mainly due to management problems and a confused personnel.

The work efficiency of the personnel is very low in all departments at the administration offices and at the plant. This situation is caused by management with neither plan of organization, nor job descriptions, and a technical management without freedom to manage, freedom to 'fire and hire' and freedom to take 'calculated risks' in the operation and maintenance of the cement plant.

It is therefore recommended that clear plans for the complete organization of the ADRA Cement Co. are prepared, confirmed and distributed to all heads of department together with job descriptions at all levels in the organization. It is of vital importance for the working spirit, as well as for the efficiency of the work, that each employee is completely familiar with his position in the organization, his job duties and his responsibility. It is the responsibility of the personnel department and the heads of departments that this information is conveyed to the employees. Examples of organization plans and job descriptions are shown by appendixes no. 9 and no. 10 respectively.

It has been noticed that the technical director at ADRA is usually spending too much time in the workshops and in the plant as stand-in for engineers and supervisors. This is of course an unfortunate situation which results in limited management control. The problem seems to be caused by low working spirit among the engineers, and fear of being accused of wrong doings from outside observers without technical knowledge or engineering background.

The technical director should normally only visit the workshops and the plant during short inspections each day. The major work duties of the technical director are in the administration of the technical department, which includes distribution and coordination of work and technical information for all plant operations. This requires a sufficient number of qualified, well organized engineers and personnel at his service, and that this personnel has freedom to take a responsibility without interference from outside the technical department.

VIII. TRAINING

The availability of personnel with proper know-how and a clear understanding of the work requirements is one of the fundamental conditions for a well functioning cement plant. Only through job experience and theoretical training can this condition be achieved and maintained.

It has been observed that training and better knowledge is required at all levels and in many subjects for the personnel and the staff of the ADRA Cement Co. A successful personnel training will improve the efficiency of the trained personnel, and in addition it will lead to a better satisfaction by the individual employee at his work duty.

It is recommended that training courses within the following subject categories should be organized for the personnel of ADRA Cement Co.:

- Basic knowledge of reading and writing.
- Basic knowledge of cement production at ADRA.
- Mechanical maintenance.
- Electrical maintenance.
- Utilization of refractories for cement kilns.
- Preventive maintenance at cement plants.
- Stores and purchase control for spareparts.
- Lubricating techniques.
- Operation and production control at ADRA.
  (E.g. training of kiln-burners, millers, quarrymen etc.).
- English

The instructors (teachers) for the training of the ADRA personnel should be chosen from the staff of the ADRA Cement Co. Presently a considerable number of engineers and experienced staff, including former school teachers, are available and should be activated as part time instructors for the proposed training courses. Also experts from other companies and organizations visiting ADRA should be invited to perform one or more lectures within their field of expertise. To achieve a proper planning and performance of the ADRA training, which should be developed in steps, it is recommended to nominate a permanent Training Manager of ADRA Cement Co.

It is further recommended that the training facilities of the existing training centre at the ADRA cement plant should be utilized for the proposed training of the ADRA personnel. This would be a good opportunity for a successful utilization of the unused training centre, which in time could be extended to training of personnel from other cement plants, as well as for personnel from the national industry for the production of building materials.

The existing 'Training Centre ADRA/S.A.R.' was erected in 1984, but it has never been completed or commissioned in spite of a large economic investment. The supplies and the construction of the training centre was based on a contract of 21.03. 1983 between GOC and SKET. The training centre was designed for vocational training of 360 skilled workers during two year programmes concerning the following vocations:

- Skilled cement worker.
- Maintenance mechanic.
- Electrician.

- Instrumentation mechanic.
- Material tester (cements).
- Cutting machine operator (lathe, milling machine).

The training centre covers in total 2500 m2 and comprises 6 class rooms, 5 workshops, laboratory and an administration section. A large amount of modern machinery, equipment and models have been supplied from GISAG/SKET and is now installed at the training centre. A list of the workshop machinery at the training centre is shown by appendix no. 11.

The total costs of the existing training centre are as follows:

Contract SKET for - Design of training centre. - Equipment. - Supervision and training of instructors. - Training of 9 technicians in DDR for two years.	1,250,000 US$
Local costs of civil engineering and other work, approximately	900,000 US$
Total investment, approximately	2,150,000 US$

Only minor investments, if any, will be required in the first steps when utilizing the existing training centre for the personnel of ADRA Cement Co.

IX. CONCLUSIONS

The three cement production lines at ADRA were commissioned in 1978 and 1985, each with a designed capacity of 1,000 t/24h. From the time of commissioning a number of serious technical and administrative problems have hampered an efficient operation of the plant. The major problems observed during the mission were the following:

- Low production rate (50%) due to design faults, weak production management, insufficient training of production personnel, damaged control equipment.
- Low kiln run-factor and high consumption of expensive kiln refractories due to lack of preventive maintenance, insufficient supervision of kiln process and installation of brick linings.

- Lack of spareparts and consumables due to financial problems and weak materials management.

Immediate improvements do not require major changes of the plant design, but the following measures are urgently required to improve the production efficiency and to avoid serious damages:

- Organization shape-up.
- Administration control.
- Stores and purchase control.
- Preventive maintenance.
- Personnel training.

The efficiency and the economy of the Adra Cement Co. can be improved to the benefit of the employees and the company in general, by a limited investment in spareparts and consumables combined with a major effort by the general management and the personnel of the company.

Apendix No. 1.

PROGRAMME FOR CEMENT PLANT EXPERT (MAINTENANCE) IN SYRIA.

Duration: Four months.
Post: DP/SYR/86/009/11-01.
Name of expert: Mr. H-H. Brandt.

01.11.88	Travel to Vienna.
02.11.-03.11.	Briefing in Vienna.
04.11.	Arrival Damascus
05.11.-06.11.	Introduction at UNDP and GOC in Damascus.
07.11.	Introduction to management at ADRA. General discussions.
08.11.-10.11.	Inspection of quarries and the cement plant by following the process flow. Discussions with management, engineers and the site engineer from the supplier SKET.
12.11.-13.11.	Inspection of workshops and stores for spare parts.
14.11.-17.11.	Discussions with technical management and stores management concerning maintenance and materials management.
19.11.	Inspection of training centre and discussions with the 'training manager'.
20.11.-24.11.	Preparation of expert report. Detailed discussions with management of plant.
26.11.-28.11.	Final preparation of expert report.
29.11.	Final discussions with the management concerning reprot conclusions. Departure from ADRA.
30.11.	Meeting at GOC concerning expert report for ADRA.
01.12.88.	Departure for Copenhagen.

03.01.89	Arrival Damascus. Start of second part of mission.
04.01.	Meetings at UNDP-Damascus and GOC.
05.01.	Meeting at GOC and briefing concerning TARTOUS Cement Co. Travel to TARTOUS.
06.01.	Introduction to management at TARTOUS.
07.01.	Introduction to General Director and management at TAROUS. Inspection of plant.
08.01.	Meeting at General Director's office with Technical Director of GOC and representatives for TARTOUS and GOC. Inspection of plant.
08.01.-18.01.	Collecting technical information and documentation. Inspection of plant and quarries.
19.01.-21.01.	Discussions with technical management concerning preventive maintenance and homogenization of lime stone.
22.01.-25.01.	Preparation of Technical report.
26.01.-	Discussions with management concerning report conclusions.
27.01.	Departure for Damascus.
28.01.-29.01.	Meetings at GOC concerning expert reports for TARTOUS and ADRA.
30.01.-31.01.	Debriefing at UNDP-Damascus.
01.02.	Travel to Vienna.
02.02.-03.02.	Debriefing at UNDP/UNIDO- Vienna concerning first part (two months) of split-mission.
31.07.89	Travel to Vienna.
01.08.	Briefing UNDP/UNIDO- Vienna.
02.08.	Arriving Damascus.

03.08.-06.08.	Briefing UNDP and GOC in Damascus.
07.08.	Travel to TARTOUS.
08.08.	Meeting with management at TARTOUS.
09.08.-28.08.	Inspections of kilns and advising on kiln maintenance. Inspections of workshops and stores for spareparts.
29.08.	Travel to Damascus.
30.08.	Meetings at GOC and UNDP in Damascus.
31.08.	Travel to Vienna and Copenhagen.
09.11.89	Arrival Damascus.
10.11.-12.11.	Meetings at GOC and UNDP, Damascus.
13.11.	Travel to TARTOUS.
14.11.-28.11.	Inspection of kilns and advising on kiln maintenance. Preparation of report.
28.11.	Travel to Damascus.
29.11.-02.12.	Final meetings and debriefing at GOC and UNDP, Damascus.
03.12.	Travel to Vienna.
04.12.-05.12.	Debriefing at UNDP/UNIDO, Vienna.
06.12.	Travel to Copenhagen.
07.12.-09.12.	Preparation of final report.

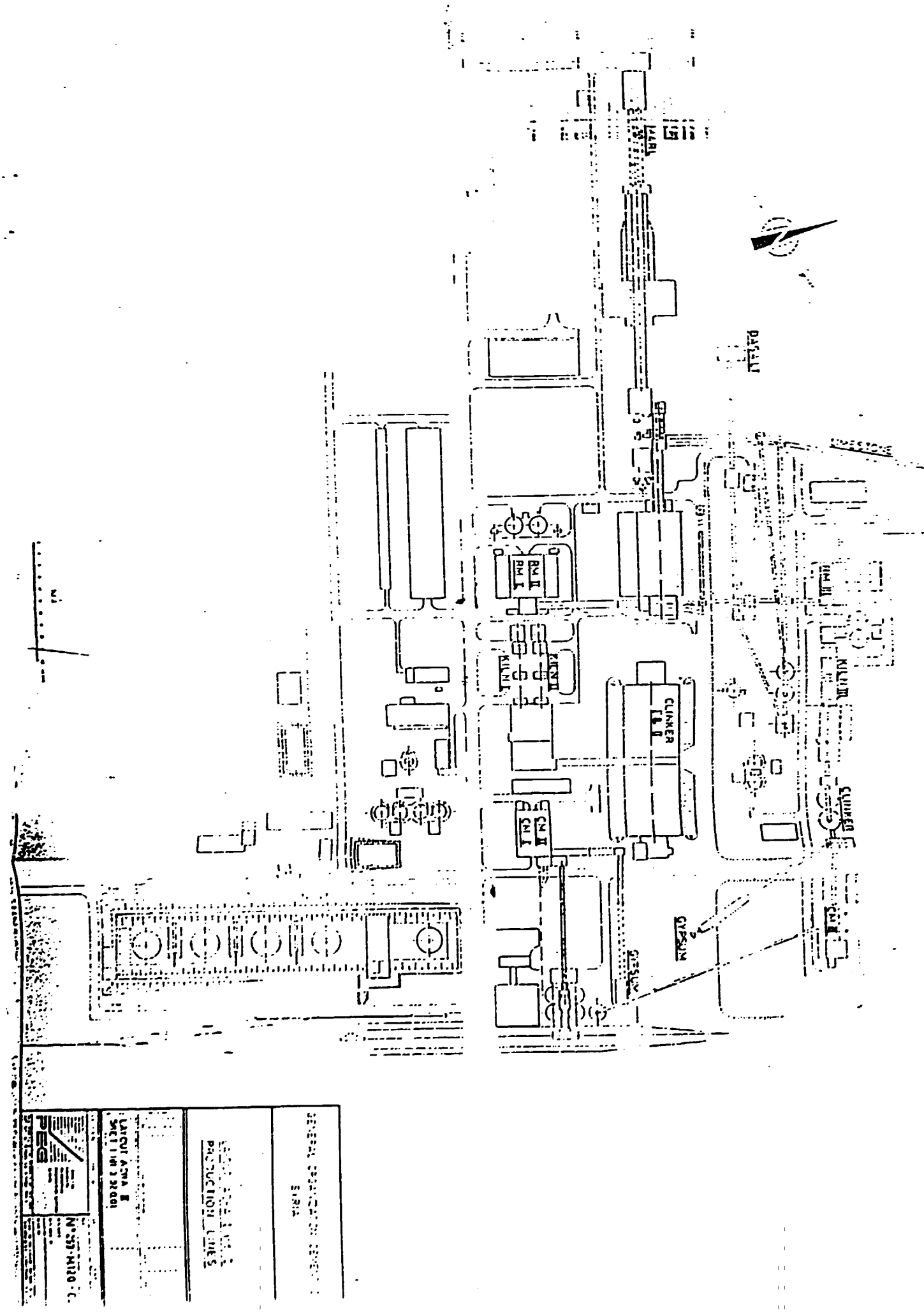
Appendix no. 2.

ADRA CEMENT CO.

List of management and senior staff met during the mission 07.11.-30.11.88.

TITLE	NAME
General Director	Eng. Adnan Afara
Technical Director	Eng. Ziad Kalash
Commercial Director	Mr. Haleem Yasigi
Financial Director	Mr. Mouhamad Arszenjani
Administrative manager	Mr. Sharif Selman
Accounts Director	Mr. Khaled Amar
Planning Director	Mr. Bassam Yamin
Training Centre; Project manager	Eng. Akram Al Roumani
Electrical Department Chief	Eng. Hesham Hamed
Mechanical Department Chief	Eng. Mouhamad Makki
Laboratory Department Chief	Chemical Ahmed Hamzeh
Instrument engineer	Eng. Ahmad Khadra
Studing Department Chief (SCS)	Dr. Eng. Mamdoh Abo Alrish
Interpreter, Foreign Affair TLX	Mr. Jamal Zaidan
Foreign Trade Department Chief	Mr. Elias Khloumi
Mechanical Maintenance Chief	Eng. Mazin Alsalti
Packing Cement Plant Chief	Eng. Sohail Saloom
Raw Materials Department Chief	Eng. Mishari AlSaid Ahmed

Appendix No. 3



Appendix no. 4.

MAJOR MACHINERY AND INSTALLATIONS.

Name of cement plant: ADRA Cement Co. Syria.

CRUSHERS FOR RAW MATERIALS

Limestone:

(Crusher type. Dimensions. Make. Year. Capacity. Crushed size)

Primary/ Double rotor hammer mill, 1800 x 1800

SKET, Dessau, DDR. 1976.

400 t/h. max. 100 cm -> 5-4 cm.

Secondary/ ---

Argilleous Materials and Gypsum:

(Material. Crusher type. Dimensions. Make. Year. Capacity. Crushed size).

Marl/ Single rotor hammer mill with movable crushing wall, 1400 x 1400.

SKET, Dessau, DDR. 1976

100 t/h.

Basalt I./ Jaw crusher, 1200 x 900.

Ernst Tallmann (SKET, Dessau, DDR). 1976

100 t/h. 100 cm -> 8 cm.

Basalt II./ Cone crusher, 1750 x 250.

VEB/SKET, Dessau, DDR. 1976

100 t/h. 8 cm -> 4 cm.

Gypsum/ Single rotor hammer crusher, 800 x 800

SKET, Dessau, DDR. 1976.

- t/h. (not in use).

DRYERS FOR RAW MATERIALS

(Dryer type. Dimensions. Make. Year. Capacity. H2O%).

No. I./ Rotary drum, 3,6 x 30.

SKET, Dessau, DDR. 1976.

70 t/h. H2O (25) 12% -> 3%.

No. II./ Rotary drum, 2,5 x 24 (approximately).

SKET, Dessau, DDR. 1976.

30 t/h. H2O (25) 12% -> 3%

RAW MILL

(Mill type. Dimensions. Make. Year. Capacity. kW. Separator).

Three identical tube mills of double rotor type in closed circuit grinding, utilizing hot kiln gasses for drying.

Mill dimension: ø 4 x 10,5 m.

Manufactured by: SKET, Dessau, DDR.

Capacity: 100 t/h.

Motor: 2500 kW Central mill drive.

Separators with outside cyclones (SKET).

Two mills ADRA I. commissioned in 1978.

One mill ADRA II. commissioned in 1983.

KILNS

(Kiln type. Dimensions. Make. Year. Capacity. Cooler. Preheater type).

Three identical dry process kilns with preheaters of Claudius Peters/SKET, shaft type preheater in three steps with top cyclones)

Kiln: ø 4 x 60 m. with grate cooler, 2 grates, total 56 m2.

SKET, Dessau, DDR.
Two kilns ADRA I. commissioned 1978.
One kiln ADRA II. commissioned 1983.

Rated theoretical capacity, each kiln: 1000 t/24h.
Capacity by SKET: 800 t/24h.

The kilns are oilfired.

CEMENT MILLS

(Mill type. Dimensions. Make. Year. Capacity. kW. Separator).

Three identical tube mills in closed circuit grinding of dimensions ø 3,6 x 14 m.

SKET, Dessau, DDR.
Two mills ADRA I. commissioned 1978.
One mill ADRA II. commissioned 1983.

Rated capacity, each mill: 70 t/h.

Motors: 2500 kW

Central mill drive.

Separators with outside cyclones (SKET).

PACKING MACHINES AND BULK DISPATCH

(Packer type. Nos. of outlets. Make. Year. Capacity. Road. Rail. Ship).

Two identical rotary packers with 14 spouts.
(Very similar to Flux packer RU from FLS).
Manufactured by PREROV MACHINERY, Czechoslovakia, 1976.
Capacity each: 100 t/h.

One rotary packer (electronic) with 8 spouts.
Manufactured by HAVER & BOECKER, W. Germany, 1983.
Capacity: 100 t/h.

Loading of 50 kg bags on trucks in 6 lines.

Loading bulk on trucksin 2 lines.

Existing rail tracks not utilized for cement.

SILOS AND STORES

		ADRA I.		ADRA II.	
Crushed limestone:		store:	14,000 t	silo:	6,700 t
Dried Marl:		store:	10,000 t	silo:	3,600 t
Crushed Basalt:		store:	1,500 t		900 t
Raw Meal:	Mixing	silos:	2x1,500 t		2x1,700 t
	Store	silos:	2x4,000 t		2x4,700 t
Clinker:		store:	80,000 t	silos:	2x10,000 t
Cement:		silos:	5 x 6,500 t		
Gypsum:					80 t

DUST COLLECTORS

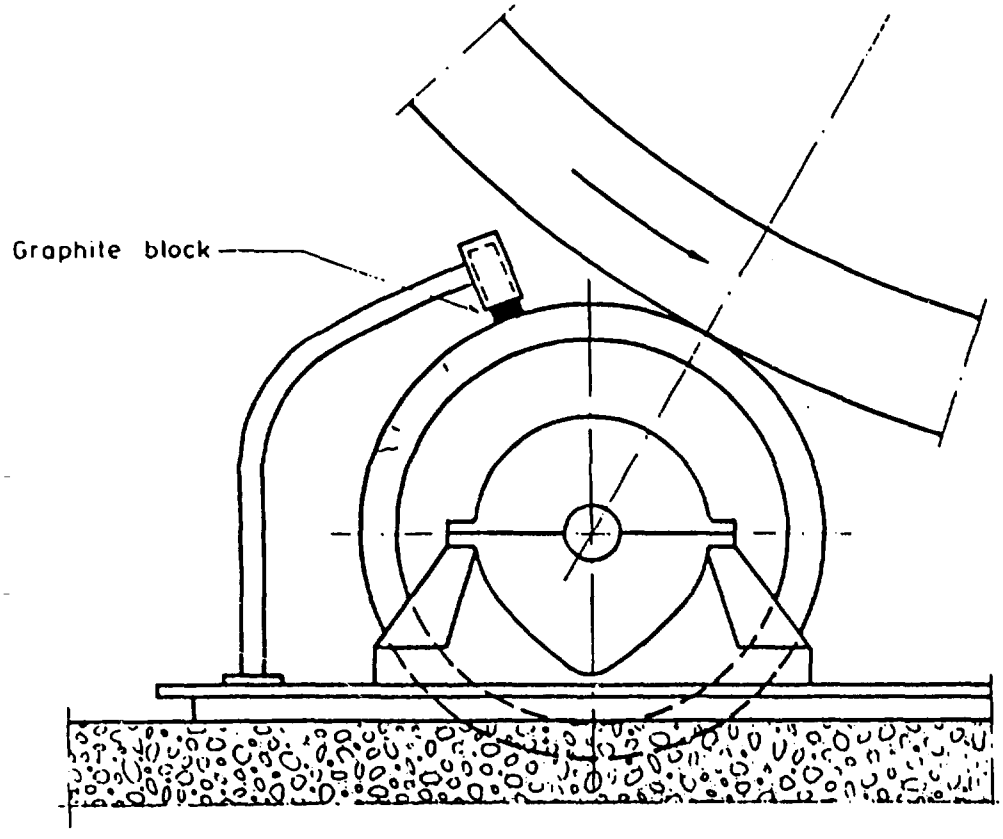
E.P.s for kilns and raw mills:	< 0.10 g/m3
Cyclones for clinker coolers:	< 0.20 g/m3
Bag filters for cement mills:	< 0.20 g/m3
Other bag filters:	< 0.20 g/m3

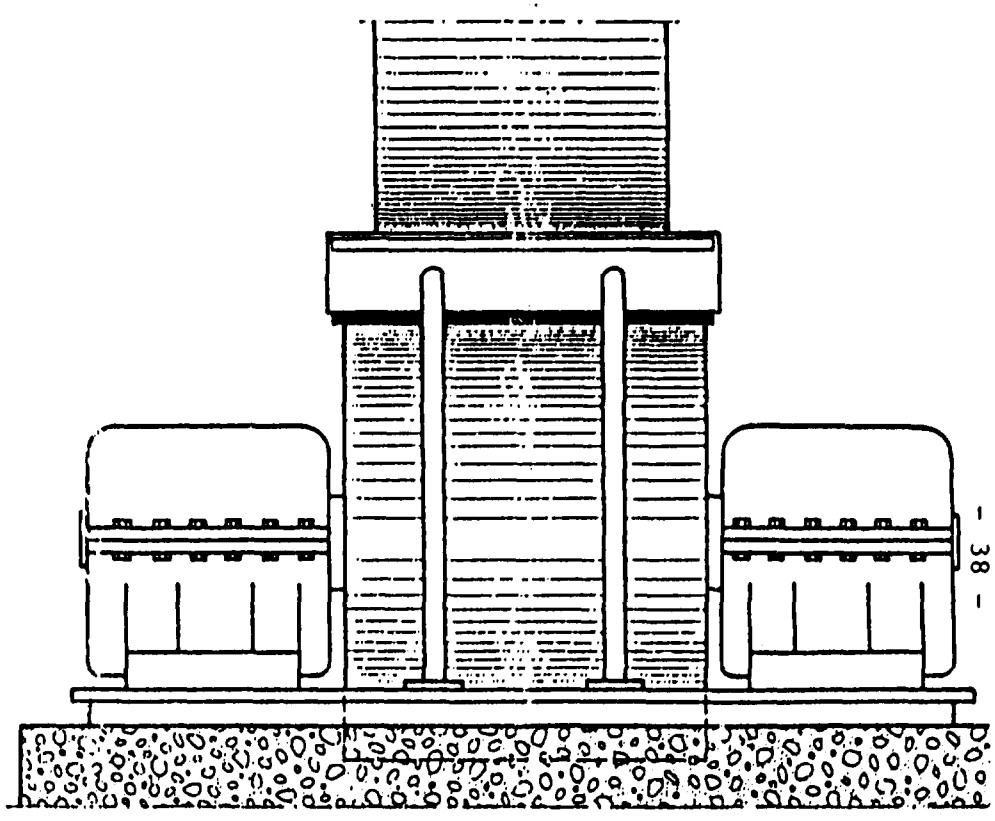
POWER SUPPLY

Supply from national hydro power station is 66 kV, which is transferred down to 6 kV at the main station for the cement plant.

WATER SUPPLY

Supply from 14 boreholes belonging to the cement co.





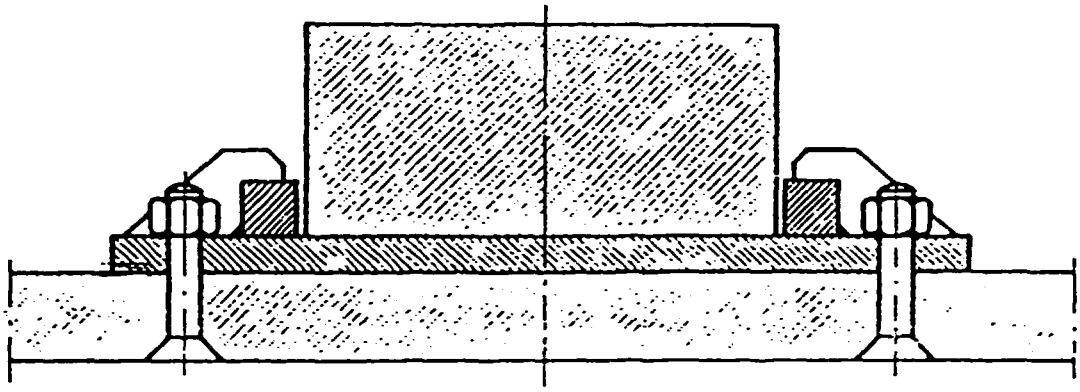
Graphite Lubrication of
Kiln Support Rollers.
Principle drawing.

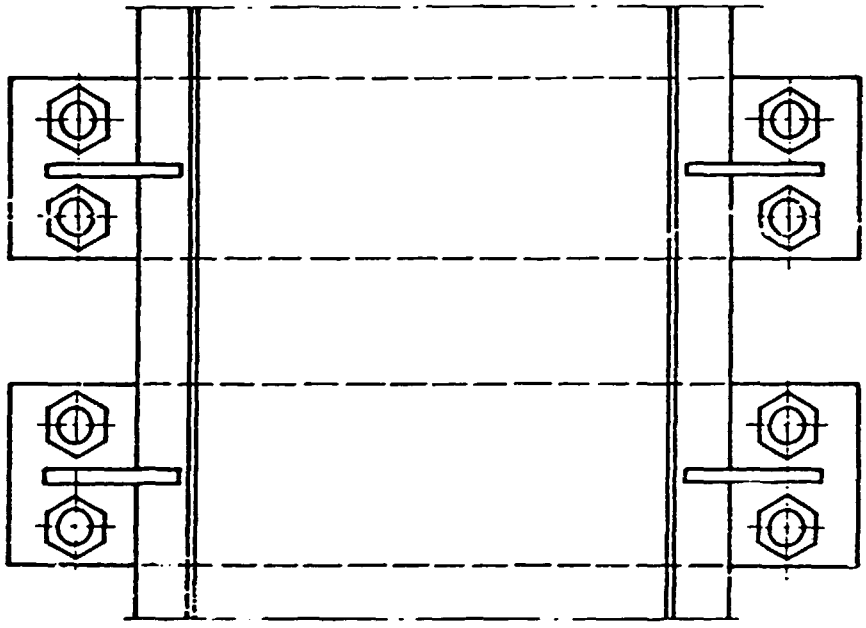
Appendix No. 5

HHB - CONSULT
CEMENT PLANT SERVICES

SCALE	DATE	SIGN.	REV. A	B
-	10.12.1988	SB/HHB		

Appendix No. 6





Live Ring Support Plates.

Principle drawing.

HHB - CONSULT

CEMENT PLANT SERVICES

SCALE	DATE	SIGN.	REV. A	B	
	10.12.1988	SB/HHB			

Appendix No. 7

ADRA Cement Company

Yearly Production and Sale of Cement 1978 88.

Year	Clinker production	Cement production	Sale	Export
1978	151,380	93,970	73,660	
1979	470,310	494,850	499,651	
1980	383,970	404,570	405,867	
1981	440,980	441,140	431,000	
1982	419,915	432,550	425,817	
1983	494,200	500,925	509,374	
1984	680,965	708,560	720,473	53,929
1985	757,900	792,050	789,801	56,358
1986	675,460	690,410	662,737	24,675
1987	670,680	610,575	598,247	48,629
1988		(500,000)		

Appendix No. 8

ADRA Cement Company.

Estimated Costs of Cement Production 1988.

Plant capacity 3,000 t/24 h by 3 process lines, dry process.

Approximate cement production 1988: 500,000 t

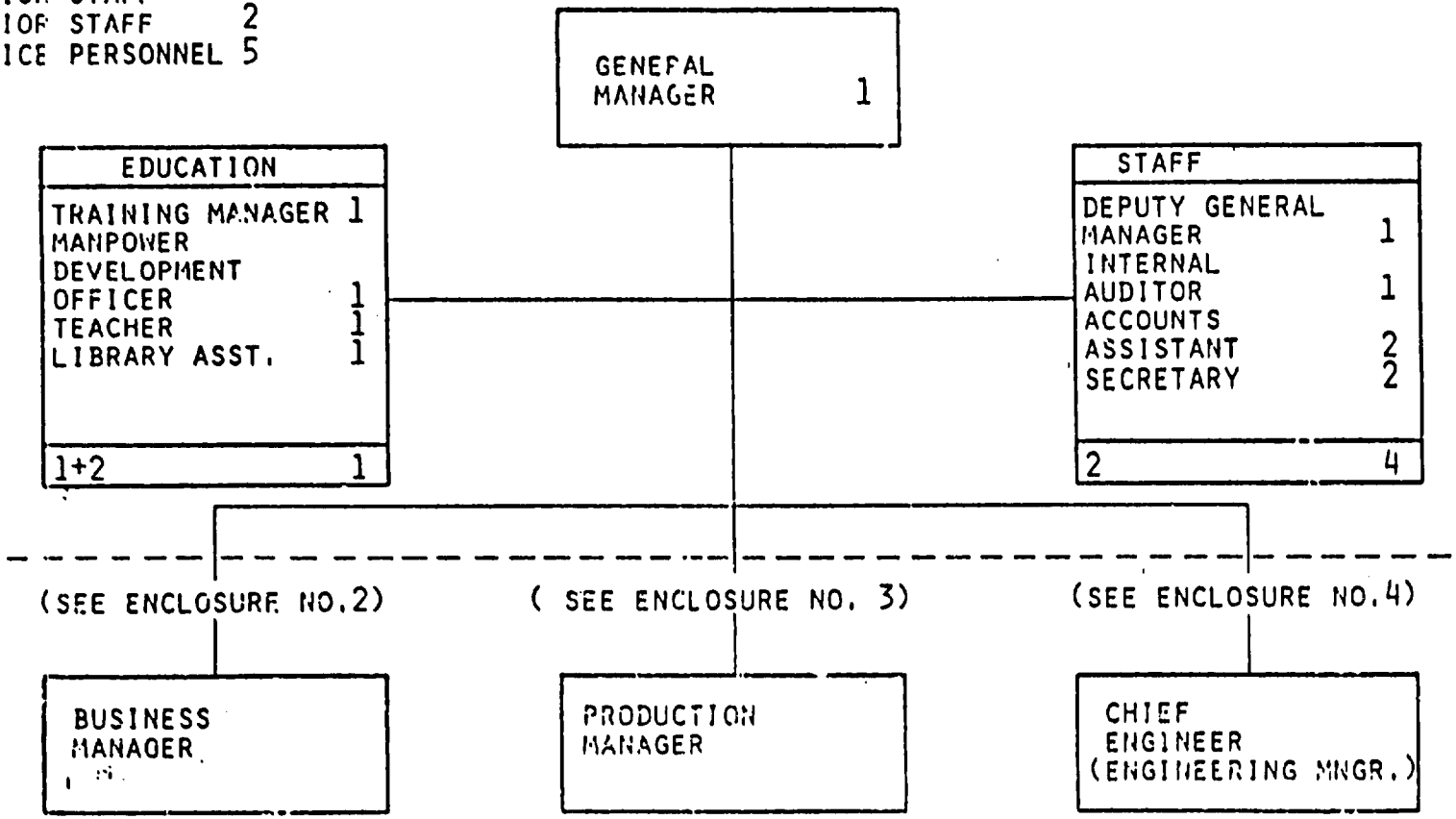
Item	LS cost/unit	Usage/t cement	LS/t cement	US$/t cement
Explosives	15,030 /t	0.104 Kg	1.56	0.142
Diesel/Petrol	2.00 /l	2.18 l	4.36	0.396
	10.00 /l	0.32 l	3.20	0.291
Lubricants	15,000 /t	0.23 l	3.45	0.314
Kiln fuel	1,319 /t	103.0 Kg	135.86	12.315
Electricity	0.36 /kWh	186.15 kWh	67.01	6.092
Water	-	-	5.09	0.463
Spareparts	-	-	11.94 *	1.085
Grinding media	7,146 /t	(0.30 Kg)	2.14	0.195
Refractories	7,995 /t	2.15 Kg	17.19	1.563
Paper sacks	2.77	21.4	59.28	5.389
Total Variable Costs			311.08	28.245
Salaries	55,358,460 LS/year		110.72	10.065
Administration and Insurances			2.83 *	0.257
Interest on loans and Amortization			57.19 *	5.200
Technical assistance			0.00	0.000
Total Fixed Costs			170.74	15.522
TOTAL COST OF PRODUCTION			481.82	43.767

* is based on 1987 as informed by accounts.

() is estimated .

Exchange rate: 1 US$ = 11 LS.

TOTAL:
MANAGERS AND
SENIOR STAFF 4
JUNIOR STAFF 2
OFFICE PERSONNEL 5

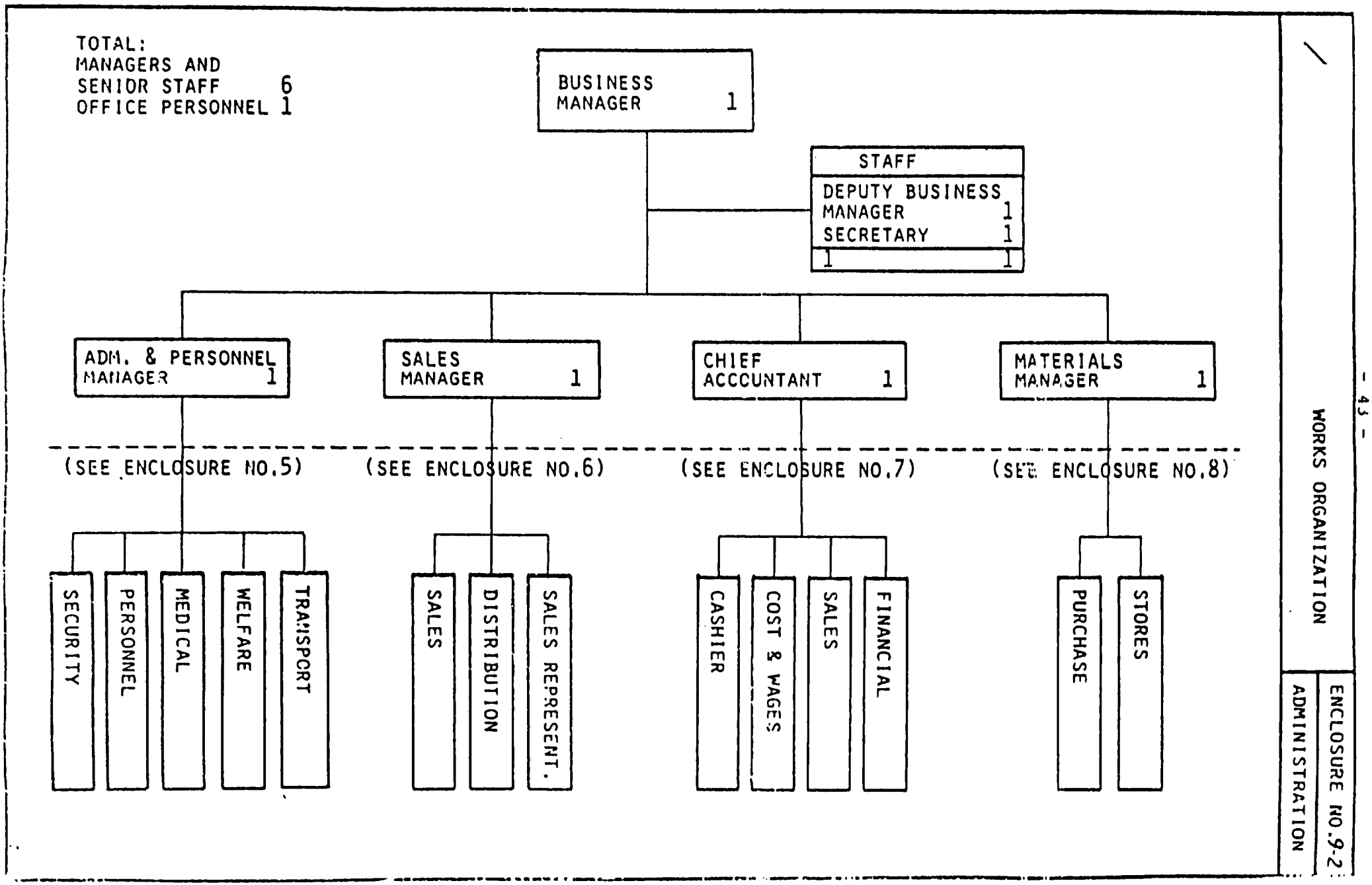


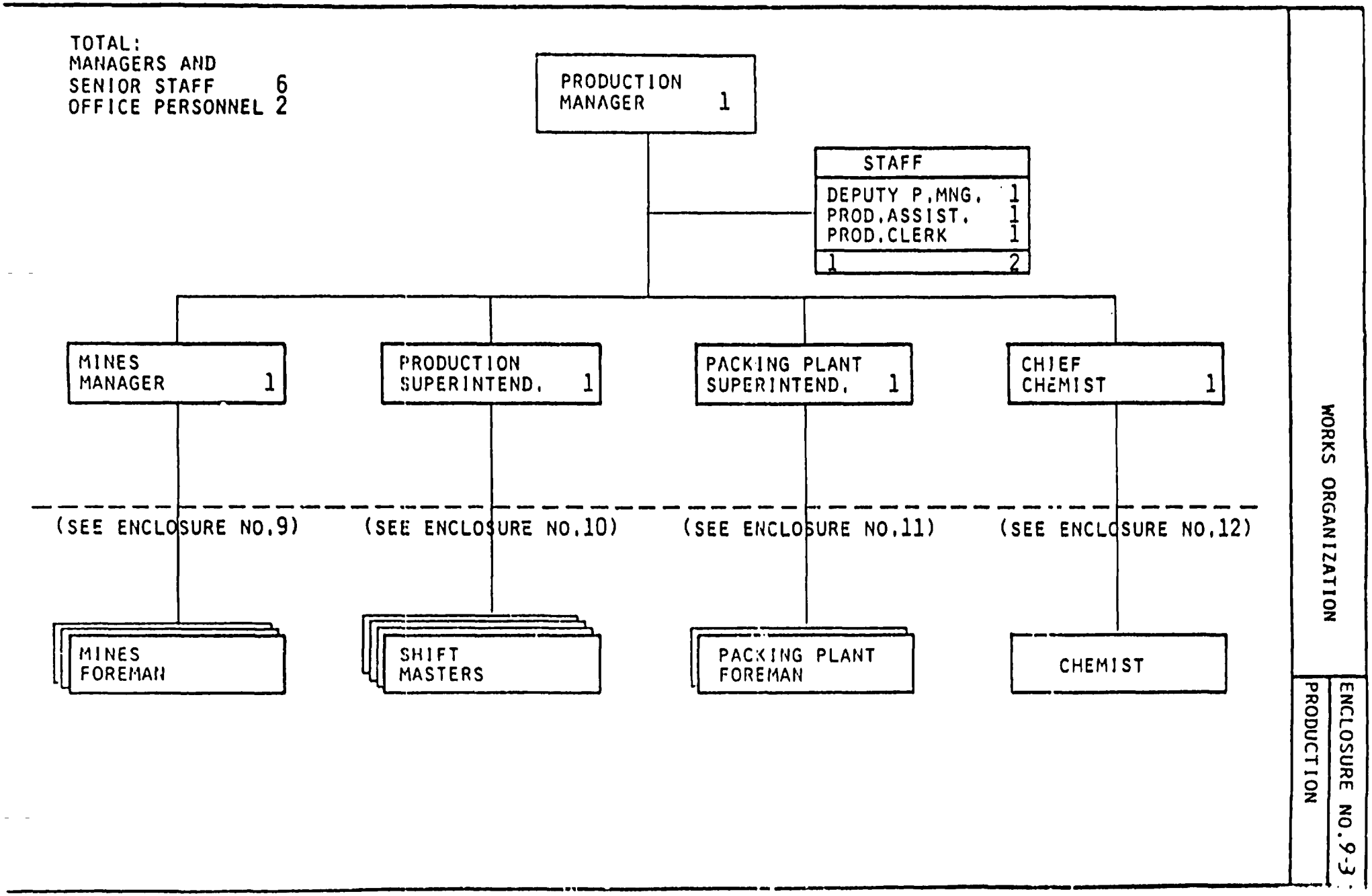
H-HB

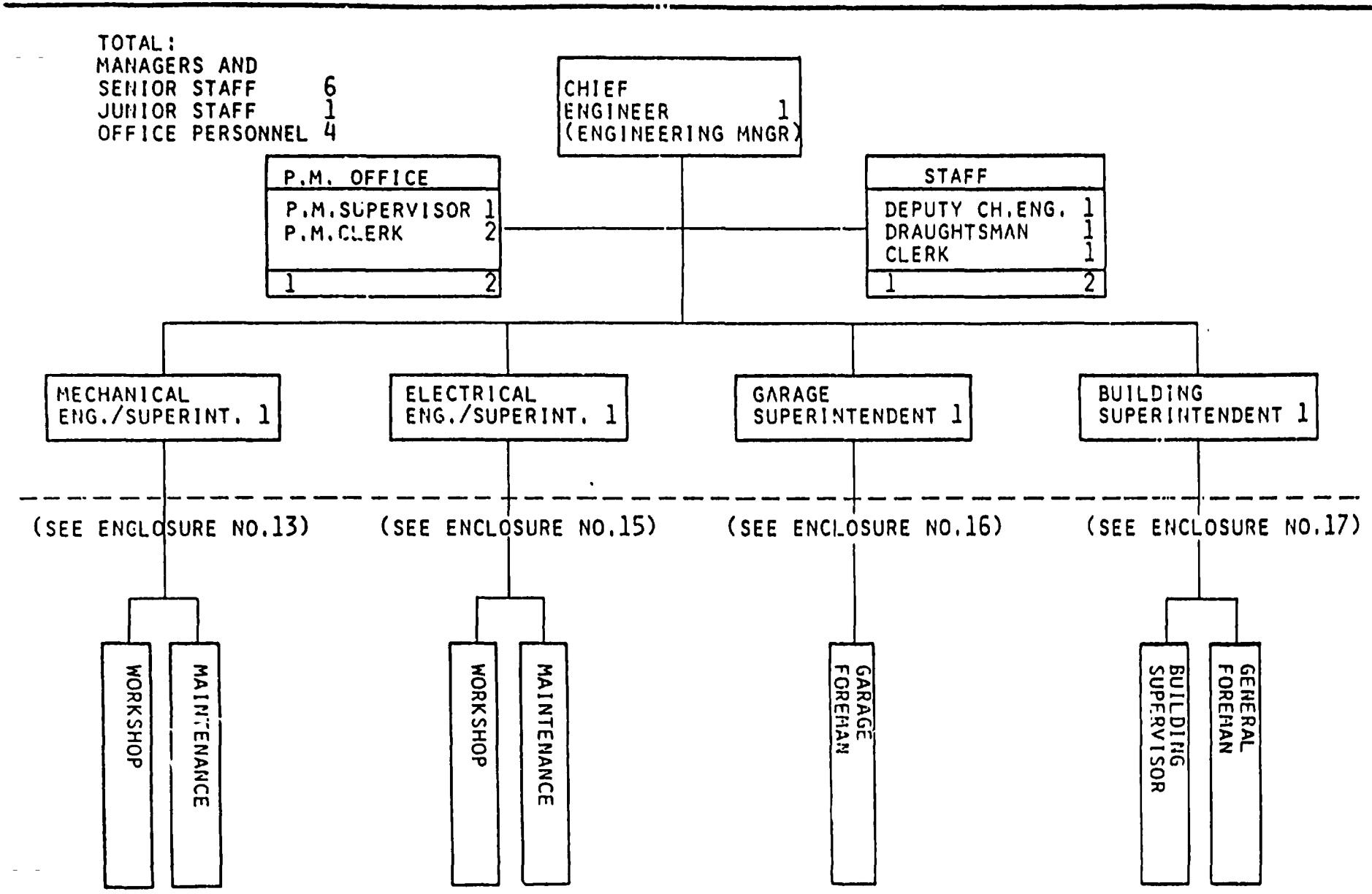
WORKS ORGANIZATION

GENERAL MNG.

ENCLOSURE NO. 9-1


TOTAL:
MANAGERS AND
SENIOR STAFF 6
OFFICE PERSONNEL 1
BUSINESS MANAGER 1
STAFF
DEPUTY BUSINESS MANAGER 1
SECRETARY 1
1 1
ADM. & PERSONNEL MANAGER 1
SALES MANAGER 1
CHIEF ACCOUNTANT 1
MATERIALS MANAGER 1
(SEE ENCLOSURE NO.5)
(SEE ENCLOSURE NO.6)
(SEE ENCLOSURE NO.7)
(SEE ENCLOSURE NO.8)
SECURITY
PERSONNEL
MEDICAL
WELFARE
TRANSPORT
SALES
DISTRIBUTION
SALES REPRESENT.
CASHIER
COST & WAGES
SALES
FINANCIAL
PURCHASE
STORES
WORKS ORGANIZATION
ADMINISTRATION
ENCLOSURE NO.9-2


TOTAL:
MANAGERS AND
SENIOR STAFF 6
OFFICE PERSONNEL 2
PRODUCTION MANAGER 1
STAFF
DEPUTY P.MNG. 1
PROD.ASSIST. 1
PROD.CLERK 1
1 2
MINES MANAGER 1
PRODUCTION SUPERINTEND. 1
PACKING PLANT SUPERINTEND. 1
CHIEF CHEMIST 1
(SEE ENCLOSURE NO.9)
(SEE ENCLOSURE NO.10)
(SEE ENCLOSURE NO.11)
(SEE ENCLOSURE NO.12)
MINES FOREMAN
SHIFT MASTERS
PACKING PLANT FOREMAN
CHEMIST
WORKS ORGANIZATION
PRODUCTION
ENCLOSURE NO.9-3

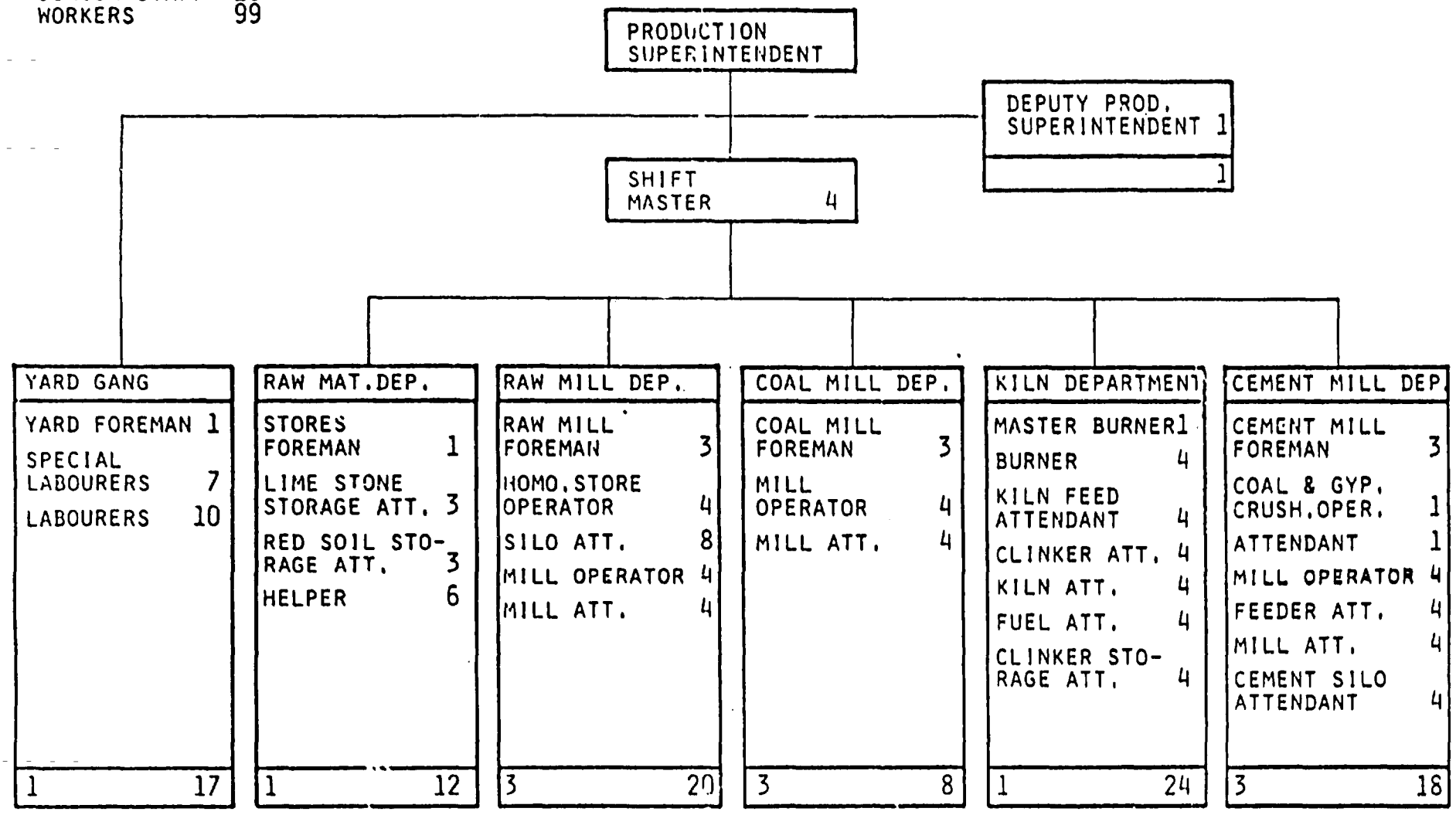


WORKS ORGANIZATION

MAINTENANCE

ENCLOSURE NO.9

TOTAL:
SENIOR STAFF 1
JUNIOR STAFF 16
WORKERS 99



WORKS ORGANIZATION

PRODUCTION

ENCLOSURE NO. 9-5

Appendix no. 10-1.

JOB DESCRIPTION

POSITION:	Stores Manager/Materials Manager
GRADE:	Divisional Manager
APPOINTED BY:	The Board of Directors
JOB SUMMARY:	Responsible for the proper administration of the Materials Division, including purchasing, receiving, inspection, storing, stores control and issuing in accordance to the policy of the company and the principles of the Stores Control System. Advise on the purchasing procedures and personally responsible for all foreign purchases.

ORGANIZATIONAL RELATIONSHIPS:

a/	Reports to:	General Manager
b/	Supervisors:	Deputy Materials Manager, Stores Controller, Purchasing Officer, Stores Officer, Receiving Officer.
c/	Works Closely with:	Chief Accountant, Technical Manager, Training Manager, Production Manager, Chief Engineer and other divisional heads.

PRINCIPAL DUTIES AND RESPONSIBILITIES:

1. Interpretation and implementation of company policy regarding purchasing and store keeping.
2. Advise on the operation of the Store Control System for materials and spares, and to ensure it's proper functioning.
3. Ensure that all functions in the Materials Division optimally protect the production, service and financial interests of the company.
4. Responsible for efficient and economical operation of the company's foreign and local purchasing functions.
5. Ensure an efficient clearing, inspection and forwarding of imported goods.

6. Ensure that the Stores Controller works closely with the Stores Accountant (from Acc. Department) to provide and extract relevant information from the Stores Control Files for the Costing Office (Acc. dep.).

7. Maintain healthy and sound business relations with the suppliers.

8. Ascertain requirement of the Company and study trade periodicals, supplier's litterature and other market information on varieties/qualities and prices available.

9. Interview vendors where possible to ascertain their ability to meet the company's specific requirement concerning quality, performance, price and delivery conditions.

10. Kep records of costs, deliveries and experienced performance concerning previous supplies, and discuss defects or advantages with user departments with a view to rectification by suppliers, or change in specifications, or change of suppliers.

11. Responsible for preparation of the budget for Materials Division, to review periodically whether budget forecasts are accurately proceeding in practice.

12. Liaise closely with Chief Accountant in all matters related to costs, expenditures, budgetting, analyses, statistics etc.

13. Guide the Purchasing Officer in purchase of machinery, equipment, spareparts, consumables, raw materials, services and other supplies for use and consumption by the company.

14. Guide the Purchasing Officer and Receiving Officer concerning discrepancy supplies, and if necessary, perticipate in negotiations with Suppliers and Shipping Agent.

15. Prepare tender procedures. Evaluate, compare and report on received tenders to the Tender Committee, of which he is a full member.

16. Negotiate contracts with suppliers and ensure that they keep within the budget and policy of the company.

17. Liaise closely with Chief Accountant for the preparation, performance and proper reporting concerning annual and semi-annual stock taking, which will be conducted by the Chief Accountant and the Auditors.

18. Ensure minimum use of cash imprest for purchasing. Responsible for full and timely retirements of such imprests.

19. Take part in the proper selection and recruitment of personnel.

20. Responsible for 'on the job training' of all personnel in the department in colaboration with the training manager.

21. Recommending to the General Manager any changes in procedure and system necessary and/or desirable in improving upon the overall performance of the Materials Management.

22. Attending to any other duties as may be assigned from time to time by the General Manager.

POSITION: Training Manager

GRADE: Manager

APPOINTED BY: Management Committee

JOB SUMMARY: Supervising and controlling the training activities for all personnel

ORGANIZATION RELATIONSHIP:

Reports to: The General Manager

Supervises: Manpower Development Officer
Teacher
Library Assistant

PRINCIPAL DUTIES AND RESPONSIBILITIES:

(1) Assesses training requirements for all personnel in the company.

(2) Consults General Manager on major training programmes.

(3) Consults departmental heads about matters relevant to training programmes such as training required, availability of trainees, availability of teachers and training facilities, financial limits.

(4) Formulates with the assistance of heads of departments realistic plans for personnel development in the company.

(5) Coordinates all the training activities in the company.

(6) Reports on training activities and results to General Manager.

(7) Takes part in the proper selection and recruitement of personnel in all departments

(8) Initiates programmes to improve communication and human relation among employees.

(9) Collects and tabulates information concerning training facilities available in and Overseas in technical college, universities, management training establishments, etc.

(10) Appraises and evaluates training courses of all kinds relevant to the needs of the company.

MAN SPECIFICATION:

Education:	Certificate from commercial or technical college or Form VI certificate.
Knowledge and Specific Experience:	Knowledge of local legislation regarding education and employment of personnel. Minimum 2 years industrial experience of which 1 year in a leading position. Fluent in English.
Personal Characteristics:	Good organizer Cooperation Flexibility.

POSITION: Production Manager

GRADE: Manager

APPOINTED BY: Management Committee

JOB SUMMARY: Supervising and controlling the activities in production department. Advisor to in the preparation and process of the cement production.

ORGANIZATION RELATIONSHIP:

Reports to: The General Manager of

Supervises: Mines Manager,
Production Superintendent,
Packing Plant Superintendent,
Chief Chemist,
Deputy Production Manager.

PRINCIPAL DUTIES AND RESPONSIBILITIES:

(1) Assesses production requirements, plant capacity and performance.

(2) Consults General Manager on the production plan and consults departmental heads about matters relevant to production planning such as financial limits, manpower available, maintenance, materials supply, marketing, and distribution.

(3) Formulates with the assistance of departmental heads the production programme including time and cost estimates, materials and personnel requirements.

(4) Controls through departmental heads the organization of work and coordinates the activities of production department.

(5) Devises procedures for inspecting and reporting production results.

(6) Reports on production plans, activities, and results to General Manager.

(7) Supervises and coordinates the work of Mines Manager and Production Superintendent, Packing Plant Superintendent and Chief Chemist, to ensure right quantity and quality.

(8) Ensures proper operation of all the main machinery units connected with production of cement.

(9) Liaises with the Chief Engineer as regards the daily operation of the various production machinery units so as to maintain a high level of quality and quantity of the product manufactured.

(10) Pays particular attention to safety by ensuring safe working practice and conditions throughout the plant.

(11) Draws realistic plans for personnel development in the department.

(12) Liaises with Training Manager with a view to ensure training and development of personnel for the department.

MAN SPECIFICATION:

Education: A university degree or equivalent in chemical or industrial engineering.

Knowledge and Specific Experience: Knowledge of local industrial legislation. Minimum 3 years industrial experience including cement works, and at least 1 year in a leading position. Fluent in English.

Personal Characteristics:
Authority
Good decision making
Good organizer
Flexibility

Appendix no. 11.

LIST OF MACHINES AND EQUIPMENT
AT THE TRAINING CENTRE ADRA/SAR.

WORKSHOP FOR SHOP MECHANICS

4 bench type drilling machines
1 cold hacksaw
3 presses
1 sheet metal bending machine
1 three-roller plate bending machine
3 sheering machines
1 cold pipe bender
1 hot cabinet
2 welder's positions
1 electrical two-fire forging furnaces
1 quenching bath
24 work benches with wices
misc. small equipment and furniture

WORKSHOP FOR MATERIALS TESTING (CEMENT)

15 preparation tables
9 service units
3 rising units
1 shocking table
1 muffle furnace
1 lab.-type cement padding mixer
1 lab.-type cylinder mill
4 balances
misc. small equipment and furniture

TRAINING ROOM FOR ELECTRICAL EQUIPMENT

misc. universal measuring instruments
misc. crank bridges
misc. power supply units
misc. measuring desks
misc. training measuring set-ups
misc. small equipment and furniture

WORKSHOP FOR ELECTRICIANS

4 bench-type drilling machines
1 metal-slitting saw
14 work benches provided with 2 vices each
misc. small equipment and furniture

WORKSHOPS FOR CUTTING MACHINE OPERATIONS

9 lathes
2 planing machines
5 milling machines
4 grinding machines
1 drilling machine
1 hack saw
misc. small equipment and furniture

Attachment II

Preliminary assessment of the general situation at the cement plant of TARTOUS CEMENT CO.

The following abbreviations have been used in this document:

US $	United States Dollar (1989)
LS	Syrian Pound at the exchange rate (1989), one US $ = 11.00 LS
UNIDO	United Nations Industrial Development Organization (Vienna)
UNDP	United Nations Development Programme (New York)
GOC	General Organization for Cement and Building Materials. (Damascus)
TARTOUS	Tartous Cement Company
DDR	German Democratic Republic
SKET	SKET veb. Zementanlagenbau, Dessau, DDR
ZAB	Zement Anlagen Bau, Dessa-, DDR
DCIL	Development Consultants International Ltd. Hong Kong
t	Metric ton = 1,000 kg
t/h	Metric ton per hour
kW	Kilowatt
V	Volt
rmp	Revolutions per minute
km	Kilometre
PM	Preventive Maintenance
Kiln support No. I	Kiln support near burner platform

ABSTRACT

Purpose of Project:	The project is aiming at laying the foundation for an upgrading of maintenance and operational routines in different branches of cement industry including manufacture of asbestos- cement products.
Post Title:	Cement Plant Expert (Maintenance).
Number:	DP/SYR/86/009/11-01/Rev.1
Objectives:	Priliminary assessment of the general situation at the cement plant of TARTOUS Cement Co. Formulate programmes and methodologies for solving technical problems and improving productivity with emphasis on maintenance.
Duration:	One month. (Split- mission of two months).
Main conclusion and Recommendations:	In spite of good management effords at the TARTOUS Cement Co., it has not been possible to reach the nominated production capacity of 2,000,000 t cement per year. This capacity is based on the production of 1,600 t/24h cement clinker by each of the four kilns installed at the plant. Due to the inhomogenious quality of lime stone and jamming of the lime stone in the storage silos it has not been possible to obtain the nominated daily clinker production capacity. Only the production of 1,000 t/24 h (max. 1,4000 t/24 h) have been obtained by each kiln. A study should be performed by consulting experts, to find efficient and low cost solutions conserning the supply of homogenious crushed limestone for the rawmills at TARTOUS.

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APPENDIXES

Due to a general shortage of spareparts and consumables such as grinding media and refractories, the maintenance and the production at the cement plant is performed at high production costs and low production out-put.
Due to beginning maintenance problems for the kilns related to age and the above mentioned conditions, the wear of each kiln is now becomming more visible and critical.
It is recommended that the following actions are taken to solve the mentioned problems:
A project study should be exersised and a report prepared concerning the installation of a prehomogenizing store for crushed limestone at TARTOUS.
Effords should be intensified to increase export of cement and clinker from TARTOUS.
A priority list of minimum import requirements concerning spareparts and consumables should be worked out every 6 months by the plant management. Funds should be allocated immediately for purchases in accordance to the list.
Specialist assistance should be called soonest from the original suppliers or a consultant engineer to perform condition checks and adjustments of each kiln in turn.
Systems for preventive maintenance should be introduced at the plant.

INTRODUCTION

During three visits of total three months the TARTOUS Cement Co. of Syria was visited by Mr. H.-H. Brandt, UNIDO expert for cement plants.

The visits were planned by the General Organization for Cement and Building Materials GOC, in Damascus as part of a four moths split-mission concerning technical advisory service to the Syrian cement industry. UNIDO post DP/SYR/86/009/11-01.

The purpose of the visit to the TARTOUS Cement Co. was to make a preliminary assessment of the situation at the plant in general and to analyse shortcommings in the maintenance and the operation of the plant, as well as to advise on corrective measures. During meatings with directors from GOC and TARTOUS Cement Co. it was enfasised from the Syrian side that a preliminary study was required to find solutions to the problems concerning homogenization of the crushed lime stone and jamming of the lime stone in the storage silos. It was requested that the expert should recommend solutions to eliminate these specific problems now hampering the complete utilization of the plant capacity and as such the increase of cement and clinker export.

The general maintenance of the plant was discussed during the visits with the engineeers and the directors of the plant. Major machines in particular the four rotary kilns were inspected and commended upon concerning maintenance and operation. Some measurements were made at the kilns together with the maintenance crews to establish the actual condition of the kilns, and to demonstrate the methodes of condition checking. The results of the measurements are shown and commended upon in this report. Due to the continuous operation of the kilns it was not possible to perform all the required condition checks and adjustments of the kilns, which should therefore take place during future stops of the kilns. It is recommended that this work is supervised by an expert.

The programme of the mission is shown by appendix no. 1, and a list of the persons met during the missin is shown by appendix no. 2.

RECOMMENDATIONS

1. It is recommended that a project study is exersised and a feasibility report is prepared concerning a prehomogenizing store for crushed lime stone. The feasibility report should analyse the problems and needs of a constant feed of a homogenious quality of crushed lime stone for the raw mills. The report should analyse alternative designs and locations of a prehomogenizing store, including project drawings and cost estimates, giving priority to local manufacture of equipment and building structures.

2. It is recommended that effords are intensified by GOC and the Syrian government to increase the export of cement and clinker from the TARTOUS Cement Co. It seams that the company only by export of cement and clinker can obtain the currency required for payments of imported spareparts and consumables. Only this way can the company survive as an economical feasible enterprise. It is therefore recommended that a more agressive marketing aproatch is adopted.

3. It is recommended that a list of the absolute minimum requirements concerning import of spareparts and consumables is worked out every six months by the plant management and GOC. Due to the present shortage of foreign currency by the company, the list should only cover the items which will be used during the planned six month production. Import of spareparts and consumables should be made in accordance to this list.

4. It is recommended that a complete condition check is made for each of the four kilns. Each condition check should comprise measurements and adjustments of the kiln alignments, inclinations and positions of support rollers, live ring movements, kiln shell deformations etc. A report for each kiln with all measurements, findings and recommendations should be prepared and discussed with the management and GOC. The kiln checking and the reports should be made by an expert assisted by engineers from the plant, and oportunity should be taken to train one or two of the engineers in kiln maintenance.

5. It is recommended that the use of alumina bricks for the burning zones of the kilns is stopped immediately. The alumina bricks should be saved for proper use when magnesite bricks are available. In consideration of the condition of the kilns, the kilns should be stopped for maintenance work and cleaning until the magnesite bricks can be correctly installed. It is especially recommended that kiln no. II is stopped immediately to avoid that further damage is developed, due to the misshape of the kiln shell.

6. It is recommended that systems for preventive maintenance (PM- systems) are introduced at the plant for proper maintenance of the cement producing machinery and equipment. The PM-systems should be simple manually operated systems, which should be gradually develloped and introduced at the plant, with priority to the most important machinery and equipment. By some guidance from an expert the system could be develloped by a group of engineers from the cement company.

I. GENERAL FEATURES OF THE PLANT

The TARTOUS cement plant is situated 9 km North of Tartous city (population approx. 100,000) on the coast of the Mediteranean sea. The distance from the plant to the coastline is 1.3 km. The plant has good connections to the national highway system, the railroads and the industrial harbour of Tartous.

The cement plant TARTOUS is a modern dry process plant of four production lines. Each production line has the capacity of 1,600 t cement clinker per day, equal to a teoretical annual plant production af 2,112,000 t cement clinker per year or approximately 2,200,000 t/year portland cement.

The first cement production by the TARTOUS Cement Co. was started in 1982 after the installation of TARTOUS -I, which comprise of two production lines, each for the production of 1,600 t/day cement by dry process. In 1983-84 the production was increased by two extra production lines of 1,600 t/day, named TARTOUS - II. The kilns and the mills of the four production lines are identical.

A plant lay-out, flow-sheets and a list of major machinery and installation in the cement plant is shown by appendixes nos. 3,4 and 5 respectively.

The TARTOUS Cement Co. is owned 100% by the Syrian Arab Republic, and is controlled by the Ministry of Industry and by the General Organization for Cement and Building Materials, GOC. The total number of employees working for the TARTOUS Cement Co. is 2,096.

The plant was supplied by SKET of Dessau, DDR, and the

consulting engineering company responsible for the project was DCIL of Calcutta, India.

The raw materials for the cement production at TARTOUS are available in rich quantity and quality. Lime stone and basalt is quarried approximately 2 km from the plant. Thorough geological investigations were conducted concerning this deposit in 1978 by VEB. Geologische Forschung und Erkundung, DDR-Halle (Saale). Sand is received by truck or railway from Palmyra (220 km), and gypsum by truck from Lattakia (90 km). The composition of raw materials for the process is as follows:

Limestone	73 - 80	%
Basalt	15 - 22	%
Sand	approx. 3.5	%

Only one type of cement is producted at TARTOUS, namely ordinary portland cement of strength grade 450 kg/cm2. Cement is dispatched in 50 kg bags or in bulk by road or railway trucks. Cement clinker have during 1989 been dispatched in bulk for export by ship from TARTOUS harbour. During 1988 the company produced in total 825,405 t cement, of which 42,855 t was exported. During the same year 31,396 t clinker were sold for export. The production and sales results 1982-88 are shown by appendix no. 6.

II. CONDITION OF PLANT MACHINERY.

A. Plant in general

Due to the few years the plant has been in use, the general wear of machinery and equipment at the plant is small. However, some wear and damage is now visible especially in the kiln sections.

The actual plant performance is far from the performance expected by the owners, and by the designers of the plant. Only approximately 50% of the plant capacity is utilized.

Some designfaults and some operationerrors have caused reductions in the production results during the past years. However, the general shortage of spareparts and consumables now experienced at the plant is more seriously hampering the satisfactory maintenance and operation of the plant resulting in the low production efficiency.

The efficiency of the raw mills and the cement mills measured in t/h and in t/kWh is far less than satisfactory mainly due to the shortage of grinding media. Also the efficiency of the kilns measured in t/h and the time of operation ("rumfactor") is low mainly due to the shortage of magnesite bricks. Three of the kilns are precently using aluminar bricks for the burning zones, causing replacements of brick linings once every month. This type of operation is very expensive in consumption of imported refractory bricks, in loss of production due to kilnstops and in consumption of fuel due to frequent cooling and heating of kilns.

The demand of cement by the national consumers is precently low, and the cement silos are constantly full, while clinker stocks are piled-up at the plant area. Effords are made by GOC to export cement and clinker, and during 1988 a total of 74,251 t cement and clinker was exported from TARTOUS. A new contract for export of 200,000 t clinker was recently signed and the shipment of this dispatch was started in January -89.

The immediate solution for solving the precent shortage of spareparts and problems in plantperformance seems to be an increased export of cement and clinker. The exelent position at the cement plant near the coast and shipping facilities for export should be utilized to the largest extend possible. This should permit the company to spend more foreign currency on spareparts and consumables which can not be manufactured in Syria. At the same time it is recommended that effords are intensified to increase the local manufacture of spareparts and consumables.

B. Kilns

The four kilns at TARTOUS are operated at low daily production rates and at low rumfactors due to the process control problems and maintenance problems. The two categories of problems are partly inflicted by the general shortage of spareparts and consumables as mentioned above. However, some of the problems could be minimized by improved operation prosedures and skill, and by increased preventive maintenance of the kilns.

The deformation of the kiln shells at all four kilns is heavy in consideration of the few years the plant has been in operation. The damage of the kiln shells is to a large extent indirectly caused by the unfortunate use of alumina bricks for the burning zones, due to the shortage of magnesite bricks. However, insufficient experience and operation control during the first years of operation have also contributed to the damage of the kiln shells. In particular the shell of kiln no. II

have now develloped to a coindition which requires an investigation comprising measurements of deformation and a study of brick lining durability time, to establish if shell replacements are necessary.

To avoid further damages of the kiln shells, the following actions should be taken:

- Instructions and guidelines for correct kiln operation should be issued and explained to all personnel in charge of kilnoperations.
- The optical phyrometres for the kiln shell temperature control and the instrumentation for the same including curvewriters and proper alarm setting should always be working when the kilns are in operation.
- Instructions and training "on the job" should be given to the personnel in charge of brick lining installations.
- Complete recording of the brick lining installations with reference to the clinker production, lifetime and quality should be introduced.
- Sufficient quantity of magnesite bricks should be supplied for use in the burning zones of the kilns. The present use of alumina bricks for the burning zones is more exp-ensive than the proper use of magnesite briks and should be stopped.
- The livering clearances should be measured one time per year and when necessarily adjusted. A correct livering clearance towards the livering support plates should be 0.5 - 3.0 mm, measured when the kiln is in normal operation.

The alignment of each kiln should be checked together with the inclination and position of all support rollers and trust rollers. The wear of some of the support rollers and the position of live rings indicates that some adjustments of support rollers are required to obtain a better balance of the axial trusts at the kilns.

The wear between the live rings and the live ring support blocks were checked at all the live rings for each kiln during the visit of the expert in August -89. The results of these measurements are shown by appendix no. 8. the measured live-ring migrations and clearances were explained and discussed with the engineers of TARTOUS. During the time between the visits of the expert in August -89 and November -89, some changes of live ring support blocks for the kilns no. 1,3 and 4 were made by the maintenance groups of the plant. The results of the adjustments were measured by the expert in November as shown by appendix no. 8. Comments concerning these adjustments will be seen in the following paragraphs for each kiln.

Some pitting and wear of the surfaces at rollers and live rings was observed. To avoid further development of this wear it is recommended to keep the surfaces of rollers and live rings clean of oil and water. This change should be made gradually and during careful observation to avoid major changes in the axial kiln trust. The cooling of the roller bearings must be maintained. As lubrication of the roller surfaces is desirable, only lubrication by graphite should be utilized. A sketch concerning graphite lubrication of kiln rollers is shown by appendix no. 7.

Kiln no. I has heavy wear of the trust rollers which indicates that some of the support rollers must be adjusted to obtain a better balance at the axial trust of the kiln. The inclination of the trust rollers should also be adjusted. Some wear of the kiln drive pinion was observed. The wear of the pinion was only at 1/3 of the tooth length, which requires an adjustment of the pinion drive soonest possible. At the same time the alignment of the kiln should be checked.

The measurements of the live ring migrations and clearances shown by appendix no. 8 for kiln no. I in August, proves that the relative movements and the wear is high at support no. I and II. Especially the live ring clearances of 23 mm. for support no. I, indicates a bad support of the kiln shell, which could crush the brick lining due to the ovality and the flexibility of the shell. In the time between the visits of the expert the 32 live ring support plates for live ring no. I were replaced by new plates of 40 mm. thickness. This adjustment redused the live ring clearance to 9 mm., which is a major improvement. To reduse the wearrate of the live ring support plates it was advised by the expert that lubrication by heavy oil containing 15 % of graphite pouder should be introdused for all the live rings. It was also advised that the wear of the live rings should be checked at least one time per year, and that adjustments by shims or new live ring support plates should be considered when the live ring clearances were exeeding 15 mm.

Kiln no. II has a bend ("banana shape") of the kiln shell between support no. I and no. II, and the shell is also very misshaped due to many old red spots. The bend of the kiln is probably caused by a kiln shut down without proper turning procedure. The damage is causing a concentric movement at the kiln hood seal of 120 mm. The damage is also causing an uneaven torque at the kiln drive and wear (pitting) of the pinion. During the inspection of August -89 it was recommended that the kiln shell should be straightened or otherwise repaired to avoid further damage especially of the pinion and the girth gear. The problem of the concentric kiln seal could be solved by cutting, straightening and welding of the misshaped kiln shell approx. 4 m. below live ring no. I. Further development of the wear at

the main drive should be watched carefully if kiln operation is continued before the repair of the kiln shell. The oil of the pinion drive should be changed and kept clean.

By the measurements of the live ring clearances during August -89 it was found that the clearance of live ring no. I was 25 mm. while the clearances of the live rings no. II and III only were 8 mm. This situation remained unchanged at the kiln inspections of November -89. To increase the life time of the brick linings as explained above and during the visits to the management of the plant, it is strongly recommended that the clearance of live ring no. I is corrected either by use of shims or a complete new set of live ring support plates.

Kiln no. III was during August -89 working in spite of a broken roller bandage at support no. II, which was later changed by a new support roller. At the same time it was observed that the kiln drive pinion only was in contact by the half length of the teeth, which should be corrected soonest possible to avoid serious damage of the kiln drive. During the kiln inspection of August -89 it was also found that the clearance of live ring no. I was 24 mm. and that the live rings no. II and III. only had a clearance of 8 mm. and 6 mm. respectively, see appendix no. 8. In the time between the visits of the expert some changes of the live ring support plates had been made in an effort to improve the conditions at live ring no. I. During the inspection of November -89 it was found that the clearance at live ring no. I had been reduced to 8-6 mm. However, it was also observed that the original 32 live ring support plates were replaced by plates of various thickness disregarding a concentric and equal support of the live ring. This situation will probably cause more damage to the bricks and more wear of the live ring than the previous situation, and should therefore be corrected as soon as possible.

Kiln no. IV had a strong force towards the lower trust roller, and the live rings of the supports no. I and no. II had heavy wear of the lower guide rings. This, together with the vibrations of the kiln foundations no. I and no. II, indicates some faults in the axial force of the kiln and the positions of kiln support rollers. Measurements and calculations of the kiln alignment should be made soonest possible, followed by adjustments of the kiln support rollers. It has been suggested that a kiln expert should be requested to assist the engineers of the plant in the proper alignment of the kiln. For this reason it has been expected that the UN-expert would assist in the alignment of the kiln during his final visit. During the kiln inspections the inclination of each support roller was measured by the expert. The results of the measurements which are shown by appendix no. 9 indicates that the inclinations of the sup-

port rollers of the kiln no. IV are satisfactory. During the kiln inspection in August -89 it was also observed that the pinion had heavy pitting over the complete length of the gear teeth. It was recommended that the oil of the kiln drive was changed, and that the wear should be carefully studied and recorded during the next kiln stops. By the measurements of the live ring clearances in August -89 it was found that the clearance of the live ring no. I was 13 mm. and the clearances of ring no. II and III were 2 mm. and 5 mm. respectively. During the visit of November -89 it was found that the clearance of live ring no. I had a variation from 2 mm. to 8 mm., and that plates of various thickness from 30 mm. to 40 mm. had been used at random for the adjustment of the clearance. This situation is similar to the situation explained for live ring no. I at kiln no. III, and should therefore be corrected.

Preventive maintenance should be introduced for the proper maintenance of the kilns. The PM- programmes should comprise programmes and records of brick linings, lubrication, checking and repairing of mechanical and electrical parts for the kilns.

III. MAINTENANCE.

When machinery and equipment is to remain in satisfactory order, it is essential that the required service intervals are followed. If this does not occur, the condition of a cement plant will within few years deteriorate to a level at which maintenance resources become totally preoccupied with breakdown repairs.

It is recommended that action should be taken immediately to introduce a planned maintenance system at TARTOUS so that the utilisation of existing resources can be maximised and a clear idea of the total maintenance load established.

The tasks involved in establishing such a system are, in broad terms:

- The cataloguing and coding of all items of plant and equipment.
- In conjunction with the equipment suppliers or a consultant and the TARTOUS engineering staff determine which items should be subject to planned maintenance.
- Determine the level of maintenance requirement and the frequency.
- Up-date spare parts stockholding parameters.
- Implement the system itself, incorporating procedures for recording of the maintenance activities carried out.

It would also be necessary to determine whether the operation of such a system would require an additional fulltime clerk assigned to the Technical Office or whether existing clerical resources would be adequate.

It is the experience that for a plant of the size of TARTOUS a proper PM-system would take up to six months to set up and would require the full time services of at least one specialist engineer for this period. It is recommended that expert assistance is called upon to implement the PM- system.

It would be necessary to make a study of the PM-requirements before detailed proposal for the appropriate PM-system could be worked out, and the proposal should be discussed and agreed with the management of the plant before being implanted.

In general, it is recommended that the PM-system should be based upon systematic inspections which would take the form of routine checks, stop checks or overhaul checks for each item of equipment. This would necessitate writing maintenance instructions for several hundred items of plant and the preparation of several times as many task cards.

A fault identified at a running check, stop check or overhaul check would be fed back to the PM-clerk and would be categorised as urgent, non-urgent or work that could wait for the next plant stop. The work would then be allocated in accordance with its priority.

At the same time, a system for the recording of work done either as a result of the planned maintenance system or as a result of a breakdown would be introduced.

The benefits resulting from a planned maintenance system will be:

- Increase of production efficiency.
- Reduction in unplanned breakdowns.
- Formal planning of work schedules.
- Assessment of maintenance labour requirements.
- Specific and precise instructions for each item of equipment.
- Planning of spares requirements.
- Identification and control of periods between maintenance overhauls.
- Improved liaison between production and maintenance and and between different maintenance sections.
- If so desired, the system may be used as the basis for recording maintenance costs, and facilitate future equipmemt selection and highlight specific design weaknesses.
- Once established, the system could be developed by computerisation.

The system outlined above should be simple to operate and should provide the basis of effective maintenance operation during the coming years.

The system will have important side benefits. For example, reporting on machinery not being lubricated properly and machines which are dirty or being misused. This alone should lead to a reduced maintenance workload.

It can even highlight training needs for the equipment operators and so lead to improved plant performance.

IV. HOMOGENIZATION OF CRUSHED LIME STONE.

A. Geology and quality of lime stone deposit.

Investigations and reports concerning the raw materials for TARTOUS have been completed as follows:

1978 VEB. Geologische Forschung und Erkundung. DDR - Halle (Saale).

"Geological Exploration of Cement Raw Materials" Volume I - IV.

1979 DCIL. Development Consultants International. Hong-Kong.

"Mining Scheme for Lime stone and Basalt Deposits" One volume.

1974 PEG. Prospective Engineering Gestion.
Switzerland.

Report concerning the handling of rawmaterials at TARTOUS.
(This report was not available during the visit to the plant).

-- The Directory of Survey.
Damascus, Syria.

"Geological Map of Syria" scale 1:200,000 with explanations.

1988 Montagi (Consulting Engineers) Co.
Sofia, Bulgaria.

"Mining Report for Lime stone and Basalt". Comprising 32 drawings of quarry area.

The conclusions of the exploration performed by VEB in 1978 were summarized as shown by appendix no. 8.

From the geological exploration report produced by VEB it will be seen that little attention was paid to the cavities of clay which were found in the lime stone deposit. The discovery of the clay was mentioned briefly at the page 78 of the VEB - report, volume I.

Quote: Little variations of the chemical composition, which occur among the individual drilling actions and among the individual sectional samples, too, are insignificant they are caused predominantly by a slight mixture with clay material. The clay material appears as infilling of joints and small karst fissures. Such little clay infillings, which do not occur in crowds and which are less than 1 m in thickness, do not impair the homogenity of the raw material. These thin intercalations belong to be habitus of the rock sequence, they were also taken into the averaging of the chemical composition. Single larger karst cavieties and karst fissures as well as partly graben-like caves with infillings of clay material were met in single borings. These karst phenomenons are typical for the whole Mediterranean region. These karst infillings with more than 1 m in thickness must be eliminated, last the homogeneity of the raw-material will be influenced. Unquote.

B. Operation and production problems.

During the years after the commissioning of the plant it has been the experience that the clay and basalt appearance in the lime stone is hampering a homogenious feed of crushed lime stone to the raw mills. This situation has developed serious problems in the homogenisation of the raw meal and the following process and quality control. It is unfortunate that the existing design of the plant does not permit any prehomogenisation of the lime stone.

It has also been experiensed that the clay is causing frequent blockings in the lime stone storage silos. This appears normally during the winter months (November - March) when the moisture content of the lime stone can be up to 7%.

Effords have been made to solve the above mentioned problems by selective quarrying of the lime stone. However, it has been found very difficult at the quarry to seperate the clay which appears in small cavities of the lime stone. This operation methode could also result in a wrong exploitation of the best lime stone leaving the poorly quality behind.

To solve the problems of blocking in the lime stone storage silos, four shock-blasters have been mounted near the bottom of each of the four silos. The schock blasters of type "Big- Blasters" from VSR- Engineering Gmbh., Germany, are functioning by shooting compressed air into the silos. However, it is understood that it is the opinion at the plant that the schock-blasters can not sufficiently solve the problems.

A project is now under way for the installation of automatic process and quality control systems, one for TARTOUS- I and one for TARTOUS- II. Each system will use x-ray spectrometric analysers for the processed materials and computerised control of the process for raw meal production and clinkerisation. The equpment for this project have been manufactured by PHILIPS and SOLAR and was supplied by COMSIP, France in 1984. The installation of the equipment is presently awaiting the supply of interfacing equipment and cables etc. from SKET. It is understood that SKET also will be responsible for the installation and the commissioning of the equipment.

It is expected that the operation and the process control of the plant will be considerably improved after the commissioning of the described equipment. However, it should be notised that the successful function of this equipment requires a very high level of maintenance skill and discipline. Special knowledge of the electronic equipment is required together with a safe stock of spareparts. The function of this system will require a continued dependence on foreign expertice and foreign supply of spareparts to a large extend.

C. Prehomogenising of crushed lime stone.

A less complicated hence more stable methode of solving the problems related to the inhomogenious and sticky lime stone would be the installation of a prehomogenising store for crushed lime stone. Unfortunately this would require a large economical investment and take more time to complete than the now planned computerised control system. However, it is assumed that many of the parts for a prehomogenising store could be manufactured in Syria, and major expenditure in foreign currency could be saved. This would also include the spareparts later required during the time of operation.

Various types and locations concerning a prehomogenising store for crushed lime stone have in the past been discussed by the management and the consulting companies at TARTOUS. During this mission an attempt has been made on request by GOC to establish some constructive guidelines for a preliminary project which could be confirmed and further detailed during a later study by a consulting company or during a following visit by a UNIDO - expert.

By the sudy of the Northern plant area and the land along the beltconveyor from the lime stone crushers to the storage silos, it has been found that the most suitable position for a prehomogenising store is the land stripe to the West of the drying station for basalt. The drawing by enclosure no. 9 is showing the lay-out for the suggested store. It was found that the Northern part of the plant area does not provide sufficient space for the store and the connecting conveyors. Also it was found that the mountain-like landscape from the crushers to the basalt drying station would require a major levelling work before the construction of a store could be started.

The recommended area for the prehomogenisation store is on two sides attached to the cement plant area, and it is presently as the property of a local farm used for olive growing. The required area for the suggested store including connecting conveyors is 100 x 500 m2. Only a small building of a farm store is located on the required area, and a small water stream is crossing the area.

The recommended position of the store is ideal for the connection of the existing belt conveyor for crushed lime stone to the new conveyors going to and from the prehomogenizing store. This will also permit the erection of the new store without interruption of the present performance of the plant. The recommended position of the store will require a minimum of new belt conveyors, as the existing inclined conveyors before the lime stone silos will remain unchanged in function. After the commissioning of the prehomogenizing store the existing belt conveyor for crushed lime stone from the crushers to the silos will remain unchanged, hence a by-passing of the prehomogenizing store is possible during maintenance of the store.

The efficiency of a prehomogenizing store depends to a large extend on the particle size and the methode of stock piling. The recommended prehomogenizing store is ideal for a particle size up to 1 inch. The stacking of the crushed lime stone is performed in two longitudinal stock piles by an overhead, reversible, portable beltconveyor, whereas the reclaiming of the stockpiles is completed in the transverse direction by a bridgescraper, i.e. by cross-cutting.

If sufficient space is not available for a store of longitudinal stock piles, the stockpiles can be arranged in a circular way, i.e. circular or round stock piles. However, the investment costs of circular stockpiles are about 30-40 % higher than that of comparable longitudinal stock piles.

A prehomogenizing store of the following features is considered ideal to meet the conditions and the requirements at the TARTOIUS cement plant:

Store capacity: 2 x 44,000 t crushed lime stone.
Store building area approx.: 40 x 360 m = 14,400 m2.
Stacker: Reversible movable belt conveyor.
Stacker capacity: 1,400 t/h.
Reclaimer: Bridge scraper.
Reclaimer capacity: 500 t/h.

The estimated costs of the prehomogenizing store are as follows:

	US $
Civil engineering and steel structure	1.8 mio.
Mechanical equipment	1.5 mio.
Electrical equipment	0.3 mio.
Total estimate in US $	3.6 mio.

This estimate is based on W. European supplies 1989.

It is recommended that a separate and detailed feasibility study is prepared concerning a prehomogenizing store for crushed limestone.

V. CONCLUSIONS

The four cement production lines at TARTOUS were commissioned during 1982 - 84, each with a designed capacity of 1,600 t/24h. From the first commissioning of the plant and until precent time a number of serious technical problems have hampered an efficient operation of the plant. The major problems observed during the missoion were the following:

- Low daily production rates (1,000 t/24h) by each production line, due to inhomogenious and sticky lime stone, design faults and damaged control equipment.

- Low production output at high production costs due to shortage of spareparts and consumables such as grinding media and magnesite bricks.

- Insufficient preventive maintenance causing increased damage of rotary kilns.

- Financial problems due to insufficient export of cement and clinker.

The following measures are recommended for urgent decision making and actions required to improve the production and maintenance at the TARTOUS cement plant:

- A feasibility study concerning the homogenious and constant supply of crushed lime stone.

- Strickt control of minimum requirements concerning spareparts and consumables. Especially the items which must be imported.

- Condition checking and mechanical adjustments for each kiln.

- Introduction of systems for preventive maintenance.

- Increased export of cement and clinker.

The efficiency and the general condition of the TARTOUS cement plant can be improved , by a limited investment in better plant design, spareparts and consumables, combined with the good effords of management and personnel.

Apendix No. 1.

PROGRAMME FOR CEMENT PLANT EXPERT (MAINTENANCE) IN SYRIA.

Duration: Four months.
Post: DP/SYR/86/009/11-01.
Name of expert: Mr. H-H. Brandt.

01.11.88	Travel to Vienna.
02.11.-03.11.	Briefing in Vienna.
04.11.	Arrival Damascus
05.11.-06.11.	Introduction at UNDP and GOC in Damascus.
07.11.	Introduction to management at ADRA. General discussions.
08.11.-10.11.	Inspection of quarries and the cement plant by following the process flow. Discussions with management, engineers and the site engineer from the supplier SKET.
12.11.-13.11.	Inspection of workshops and stores for spare parts.
14.11.-17.11.	Discussions with technical management and stores management concerning maintenance and materials management.
19.11.	Inspection of training centre and discussions with the 'training manager'.
20.11.-24.11.	Preparation of expert report. Detailed discussions with management of plant.
26.11.-28.11.	Final preparation of expert report.
29.11.	Final discussions with the management concerning reprot conclusions. Departure from ADRA.
30.11.	Meeting at GOC concerning expert report for ADRA.
01.12.88.	Departure for Copenhagen.

03.01.89	Arrival Damascus. Start of second part of mission.
04.01.	Meetings at UNDP-Damascus and GOC.
05.01.	Meeting at GOC and briefing concerning TARTOUS Cement Co. Travel to TARTOUS.
06.01.	Introduction to management at TARTOUS.
07.01.	Introduction to General Director and management at TAROUS. Inspection of plant.
08.01.	Meeting at General Director's office with Technical Director of GOC and representatives for TARTOUS and GOC. Inspection of plant.
08.01.-18.01.	Collecting technical information and documentation. Inspection of plant and quarries.
19.01.-21.01.	Discussions with technical management concerning preventive maintenance and homogenization of lime stone.
22.01.-25.01.	Preparation of Technical report.
26.01.-	Discussions with management concerning report conclusions.
27.01.	Departure for Damascus.
28.01.-29.01.	Meetings at GOC concerning expert reports for TARTOUS and ADRA.
30.01.-31.01.	Debriefing at UNDP-Damascus.
01.02.	Travel to Vienna.
02.02.-03.02.	Debriefing at UNDP/UNIDO- Vienna concerning first part (two months) of split-mission.
31.07.89	Travel to Vienna.
01.08.	Briefing UNDP/UNIDO- Vienna.
02.08.	Arriving Damascus.

03.08.-06.08.	Briefing UNDP and GOC in Damascus.
07.08.	Travel to TARTOUS.
08.08.	Meeting with management at TARTOUS.
09.08.-28.08.	Inspections of kilns and advising on kiln maintenance. Inspections of workshops and stores for spareparts.
29.08.	Travel to Damascus.
30.08.	Meetings at GOC and UNDP in Damascus.
31.08.	Travel to Vienna and Copenhagen.
09.11.89	Arrival Damascus.
10.11.-12.11.	Meetings at GOC and UNDP, Damascus.
13.11.	Travel to TARTOUS.
14.11.-28.11.	Inspection of kilns and advising on kiln maintenance. Preparation of report.
28.11.	Travel to Damascus.
29.11.-02.12.	Final meetings and debriefing at GOC and UNDP, Damascus.
03.12.	Travel to Vienna.
04.12.-05.12.	Debriefing at UNDP/UNIDO, Vienna.
06.12.	Travel to Copenhagen.
07.12.-09.12.	Preparation of final report.

Appendix No. 2.

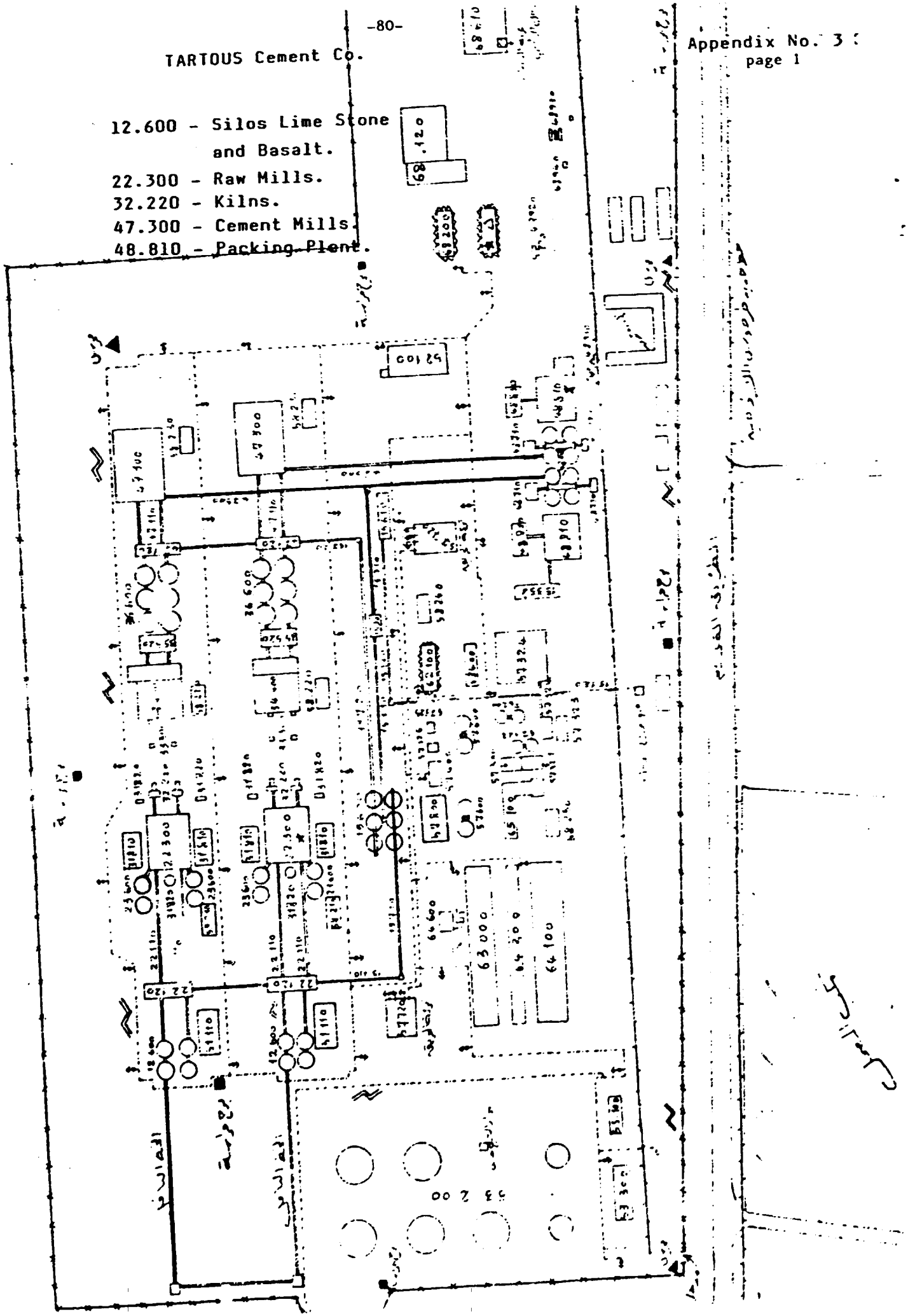
TARTOUS Cement Co.

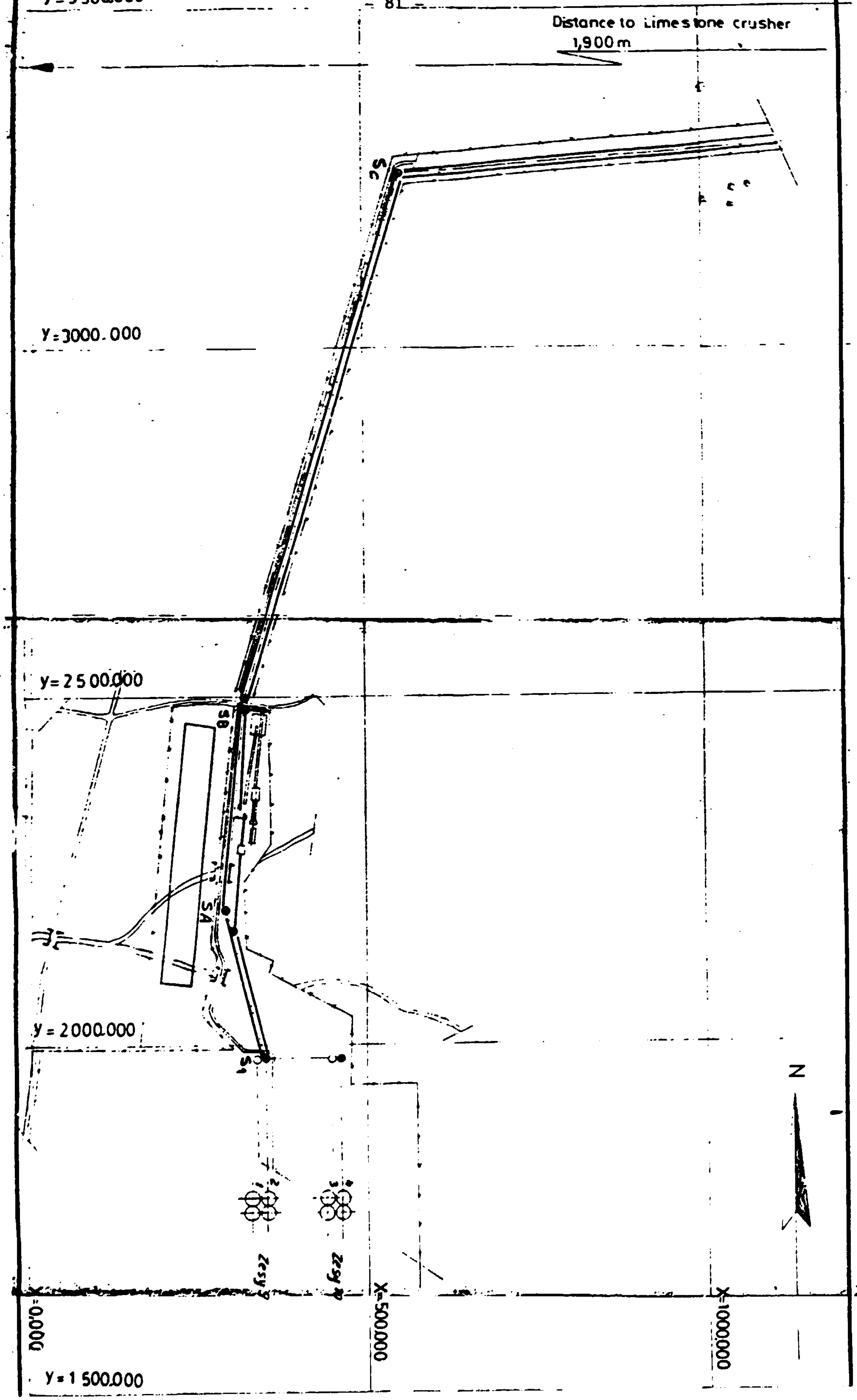
List of management and senior staff from GOC and TARTOUS met during the mission 03.01.89.-03.02.89.

TITLE	NAME
Director of GOC	Eng. Hani H. Nabulsi
Technical Director of GOC	Eng. Tayseer Basbous
Electrical Engineer of GOC	Eng. Adel Rustom
Chemical Engineer of GOC	Eng. Hassan Al'ash
Industrial Engineer of GOC	Eng. Mohammed Makhlouf
Director of GOC	Eng. Anas Semsam
General Director of TARTOUS	Eng. Salim Issa
Production & Maintenance Director	Dr. Adnan Fakhri
Commercial Director	Mr. Abbas Wannous
Engineer	Eng. M. Aiman Domlog
Quarry Chief Engineer	Eng. Abdul Karim Ibrahim
Chief Electrical Engineer	Eng. Nadim Murei
Chief Mech. Workshops	Eng. Ali Atie
Project Superintendent of DCIL	Eng. P.K. Banerjee

TARTOUS Cement Co.

12.600 - Silos Lime Stone and Basalt.
22.300 - Raw Mills.
32.220 - Kilns.
47.300 - Cement Mills.
48.810 - Packing Plent.




y = 3500.000
Distance to Limestone crusher
1,900 m
SC
y = 3000.000
y = 2500.000
SB
SA
y = 2000.000
S1
Zesy
X=0.000
X=500.000
X=1000.000
y = 1500.000
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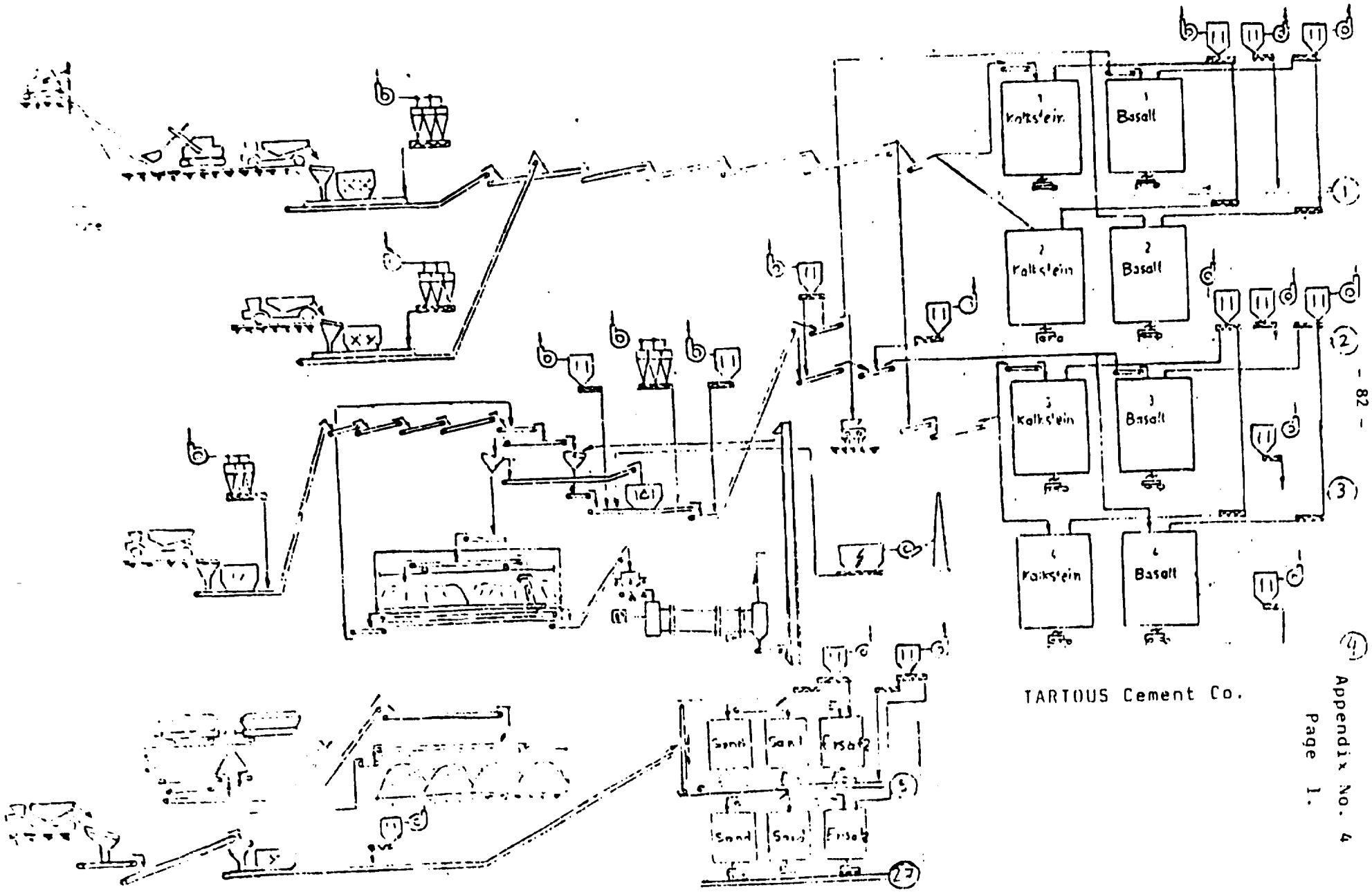

TARTOUS Cement Co.

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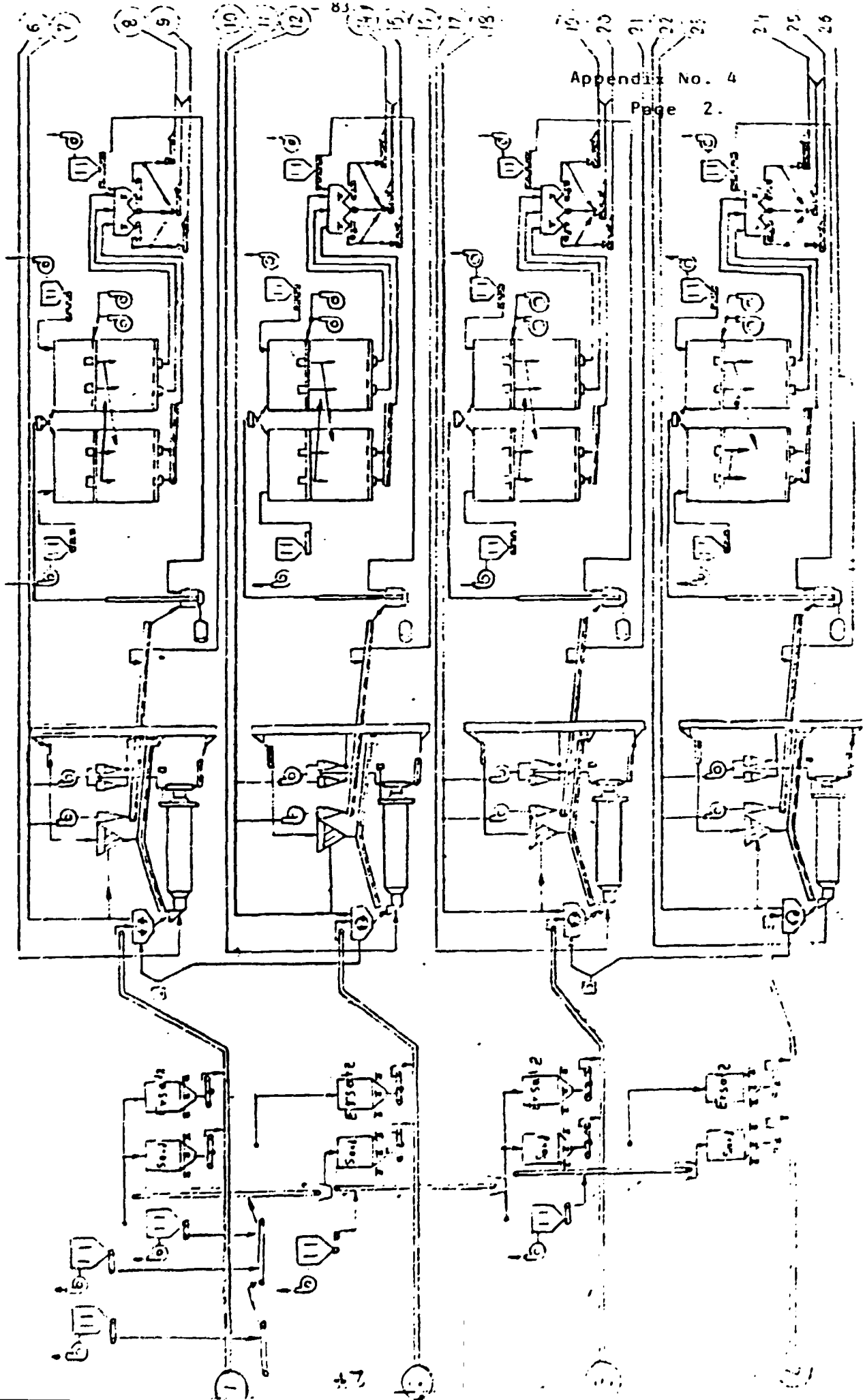

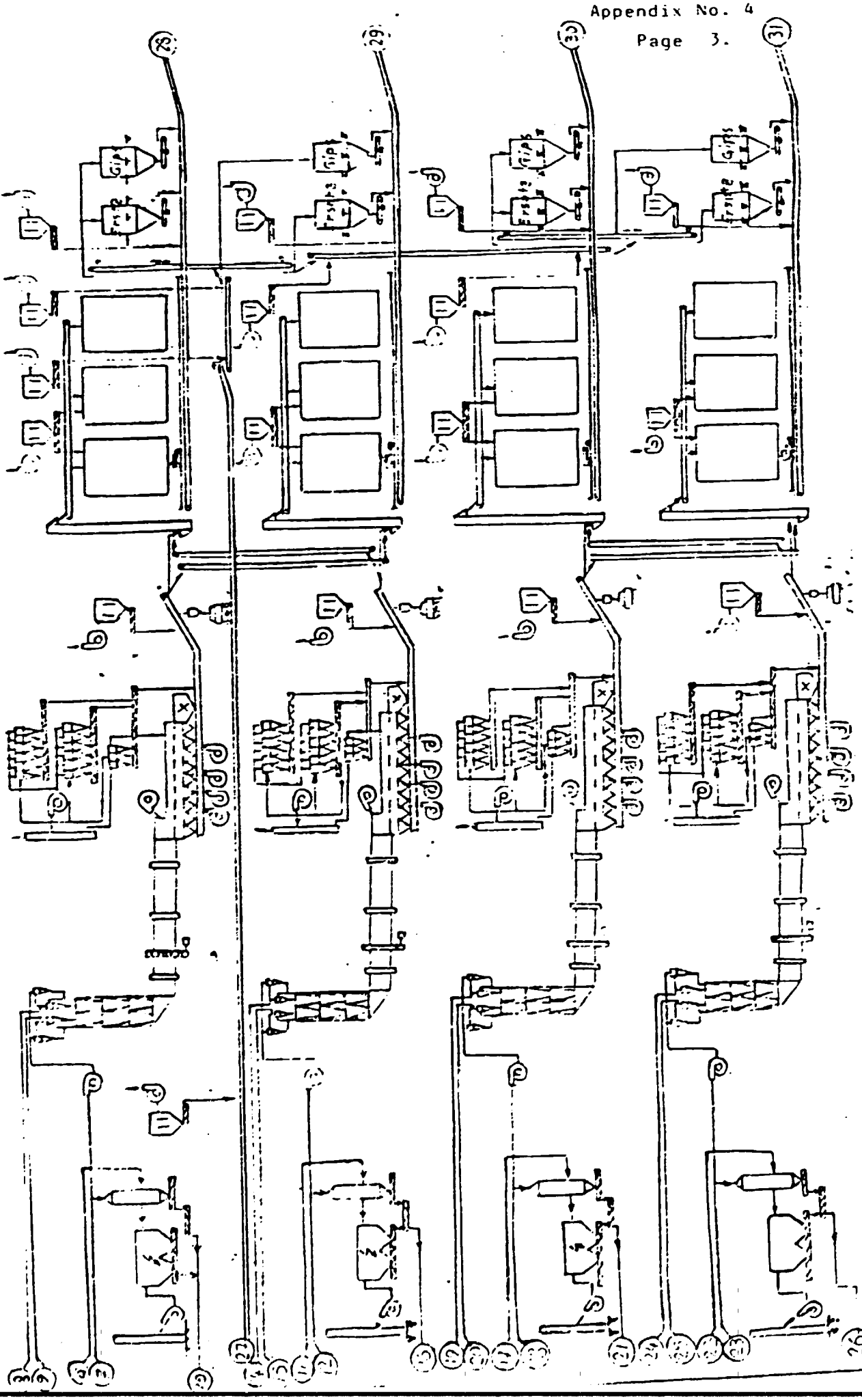

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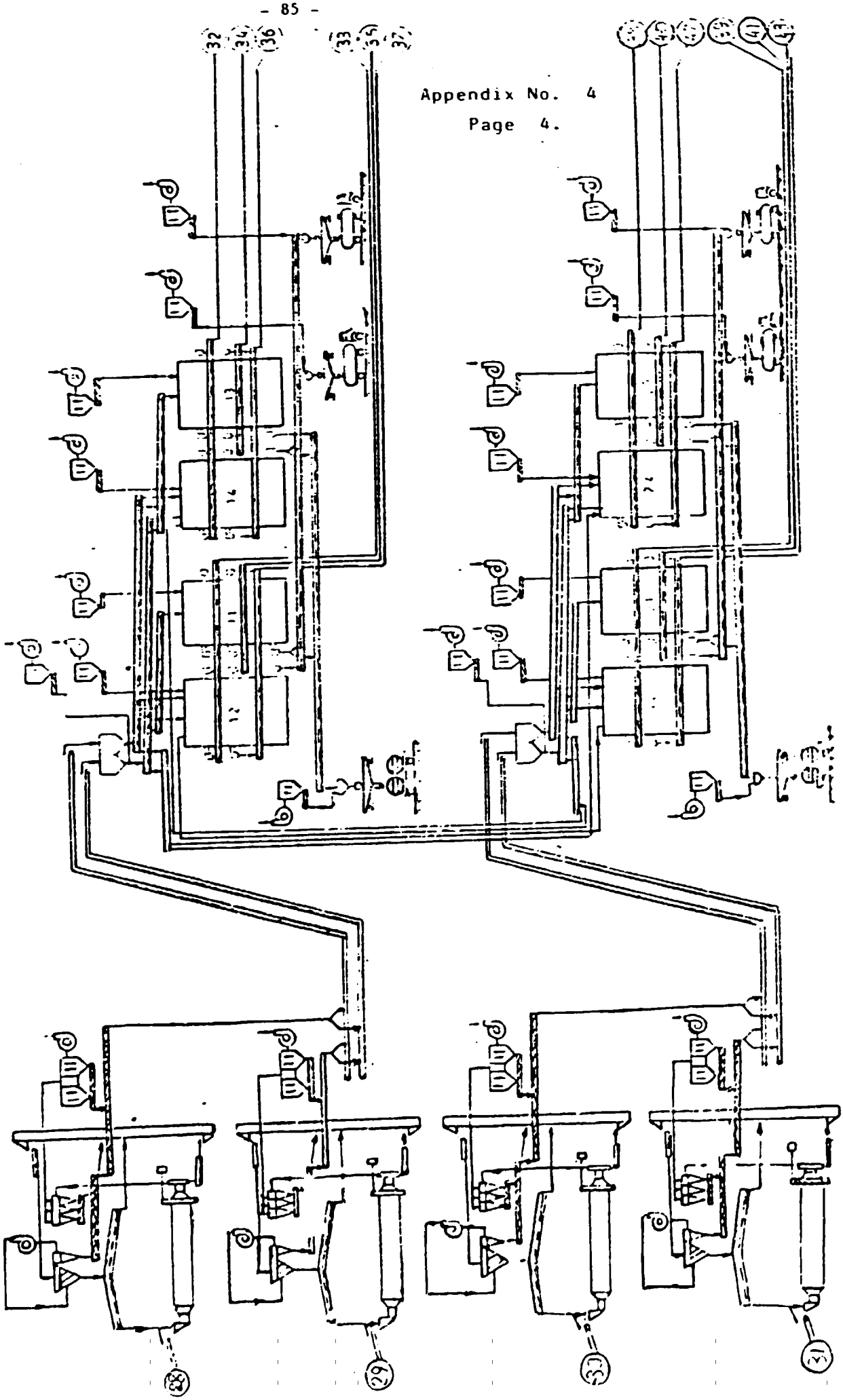

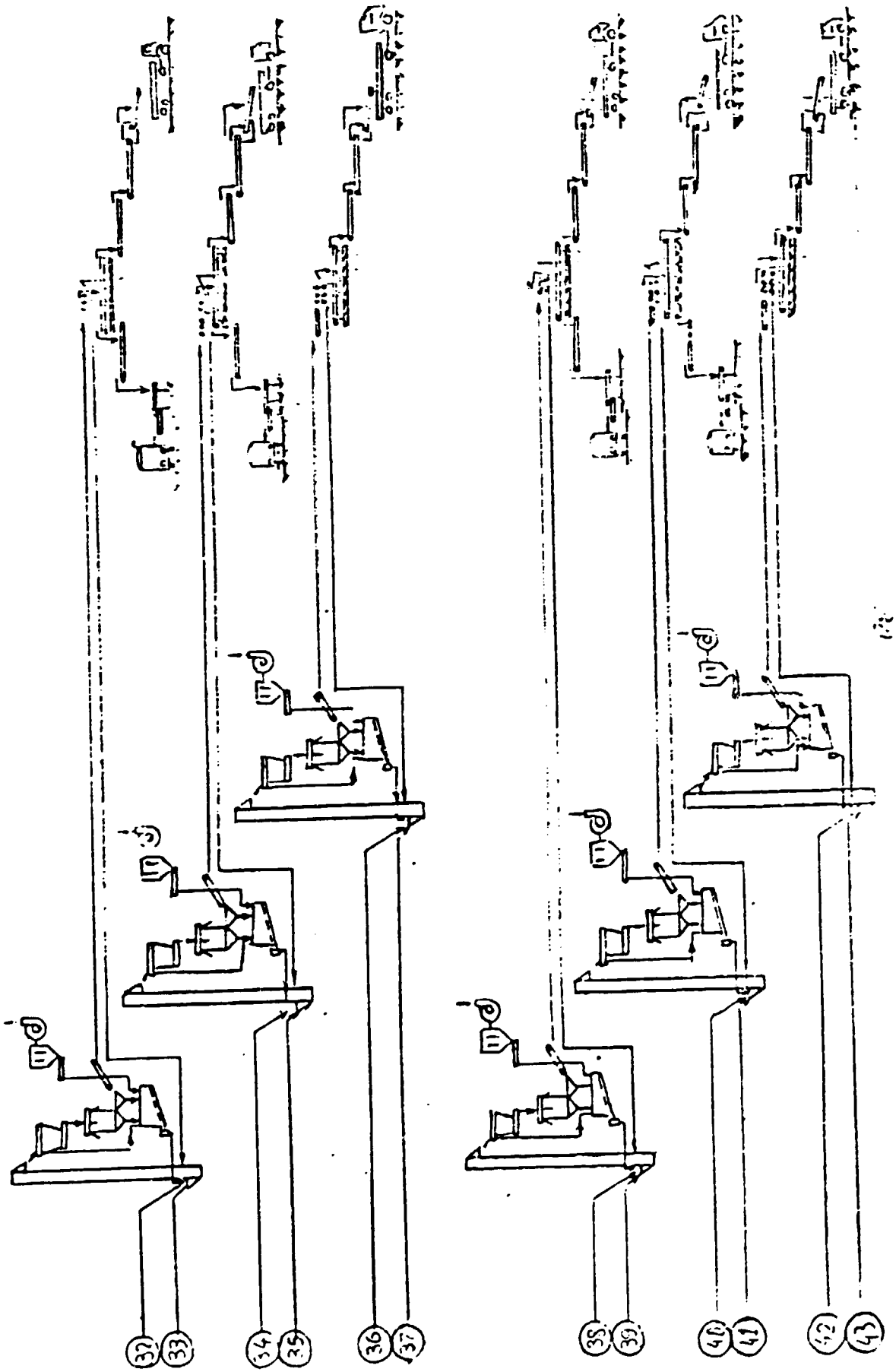
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TARTOUS Cement Co. Syria.

MAJOR MACHINERY AND INSTALLATIONS.

CRUSHERS FOR RAW MATERIALS

Limestone:

(Crusher type. Dimensions. Make. Year. Capacity. Crushed size).

Primary / Two Double rotor hammer mill, 2200 x 2200.
SKET, Dessau, DDR. 1977.
620 t/h. max. 1,200 mm - 10% above 9 mm.

Secondary / Nil

Argillaceous Materials and Gypsum:

(Material. Crusher type. Dimensions. Make. Year. Capacity. Crushed size).

Marl / Nil

Basalt I / One Jaw crusher, 1200 x 900.
Ernst Tallmann (SKET, Dessau, DDR.). 1977
200 t/h 100 cm -> 8 cm.

Basalt II / One Flat cone crusher, 1750 x 250.
SKET, Dessau, DDR., 1977
200 t/h. max 250 mm - discharge 15-65 mm.

Gypsum / One Single rotor impact crusher, 1000 x 1000.
SKET, Dessau, DDR., 1977
60 t/h.

DRYER FOR BASALT.

(Dryer type. Dimensions. Make. Year. Capacity. H20%).

One Rotary drum dryer, 3.6 x 30 m.

SKET, Dessau, DDR., 1977.

100 t/h. H20% (25) 20 -> 8.

INTERMEDIATE STORE FOR BASALT.

(Store type. Dimensions. Make. Year. Capacity).

One Roofed open-air store (heap).

One heap approx. 1,500 t.

One full portal side- reclaiming scraper.

Reclaiming capacity 180 t/h.

One reversing belt conveyor for

discharge capacity 200 t/h.

SKET, Dessau, DDR., 1977

RAW MILL.

(Mill type. Dimensions. Make. Year. Capacity. kW. Separator).

Four identical tube mills for closed- circuit grinding installed with impact driers SPT 16.20 (single rotor), bucket elevators, and seperators.

Mill dimension: ø 4.0 x 7.0 m.

Manufactured by: SKET, Dessau, DDR.

Capacity: 145 t/h.

Motor: 1,600 kW (Pinion mill drive).

Separators with outside cyclones (SKET).

Two mills TARTOUS I. commissioned in 1982.

Two mills TARTOUS II. commisioned in 1983-84.

KILNS.

(Kiln type. Dimensions. Make. Year. Capacity. Cooler. Preheater type).

Four identical dry process kilns witk preheaters of two- strand shaft- type, design ZAB.

Kiln: ø 4.6 x 69 m. with grate cooler, surface 62 m2.

SKET, Dessau, DDR.

Two kilns TARTOUS I.commissioned 1982.

Two kilns TARTOUS II. commissioned 1983-84.

Rated theoretical capacity, each kiln: 1,600 t/24h.

The kilns are oil fired.

CEMENT MILLS.

(Mill type. Dimensions. Make. Year. Capacity. kW. Separator).

Four identical tube mills in closed cicuit grinding, installed with bucket elevators and separators.

Mill dimension: ø 4.4 x 15 m.

Manufactured by SKET, Dessau, DDR.

Capacity: 120 t/h.

Motors: 2x 2,100 kW (double pinion drive).

Separator for each mill with cyclones (SKET).

PACKING MACHINES AND DISPATCH.

(Packer type. No's of out-lets. Make. Year. Capacity. Road. Rail. Ship).

Four identical rotary packing machines with 8 spouts each. Type H&B - Compact.

Manufactured by HAVER & BOECKER, W. Germany 1985-87

Capacity: 120 t/h.

Loading and dispach facilities as follows:

10 lines for baged cement (50 kg) to tracks.

1 line for baged cement (50 kg) to rail tracks.

3 lines for bulk cement to tracks.

2 lines for bulk cement to rail tracks.

SILOS AND STORES.

		TARTOUS I.		TARTOUS II.
Crushed lime stone:	silos	2 x 11,000 t.	silos	2 x 11,000 t.
Basalt: open-air	store	1 x 1,5000 t.		
Basalt:	silos	2 x 9,400 t.	silos	2 x 9,400 t.
Sand:	silo	1 x 3,500 t.	silo	1 x 3,500 t.
Iron ore:	silo	1 x 2,000 t.		
Gypsum:	silo	1 x 3,500 t.	silo	1 x 3,500 t.
Basalt (admixture):	silo	1 x 2,000 t.		
Sand (feed silo):		800 t.		
Iron ore (feed silo):		800 t.		
Raw meal double-deck				
Silos for mixing:		4 x 1,100 t.		4 x 1,100 t.
Silos for storage:		4 x 4,700 t.		4 x 4,700 t.
Clinker:	silos	6 x 9,700 t.	silos	6 x 9,700 t.
Cement:	silos	4 x 7,500 t.	silos	4 x 7,500 t.

DUST COLLECTORS.

E.P.s for basalt dryer and kilns:	<	0.10	g/m3
Cyclones for crushers, clinker coolers, raw mills and cement mills:	<	0.20	g/m3
Bag filters for crushers, conveyors, silos and cement mills:	<	0.20	g/m3

POWER SUPPLY.

Supply from national hydro and steam power stations is 66 kW, which is transfered down to 6 kW at the main station for the cement plant.

WATER SUPPLY.

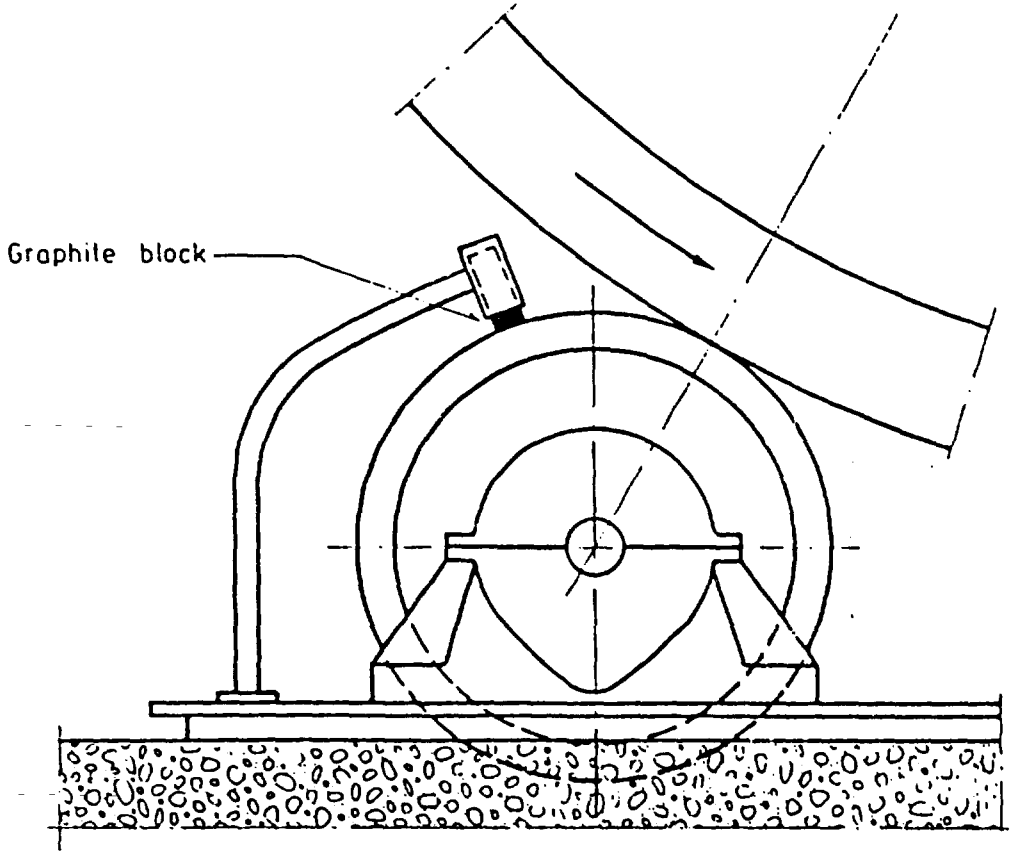
Supply from bore holes belonging to the cement company.

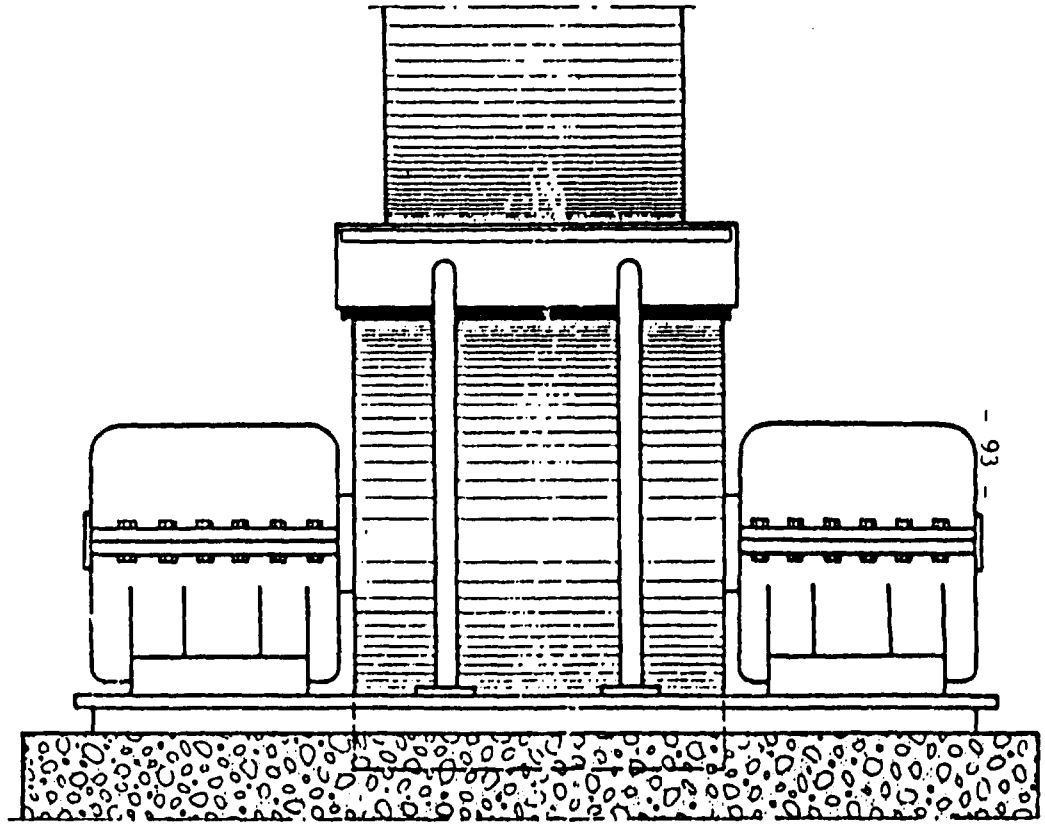
Process water required:	max. 188 m3/h.
Cooling water circulation:	1,500 m3/h.

TARTOUS Cement Co. Syria.

PRODUCTION OF CEMENT, SALES AND EXPORT FROM 1982 TIL 1988.

Year	Clinker Production	Cement Production	Cement Sales	Clinker Sales	Cement Export	Clinker Export
1982	228810	212491	197529	-	-	-
1983	819367	826356	769948	-	-	-
1984	1239433	1220854	1209875	-	-	-
1985	1131062	1252854	1222924	-	36425	-
1986	1244331	1288001	1266557	-	8569	-
1987	1215139	1116754	1072273	65634	11403	-
1988	1131337	825405	791176	38363	42855	-
1989	1200000 Exp.					Exp. 600000





The graphite block must slide free in the holder, and is forced towards the roller only by gravity.
As a supplementary function, the graphite holder is an efficient protection against personnel being caught between the live ring and the roller.

Graphite Lubrication of
Kiln Support Rollers.
Principle drawing.

HHB - CONSULT
CEMENT PLANT SERVICES

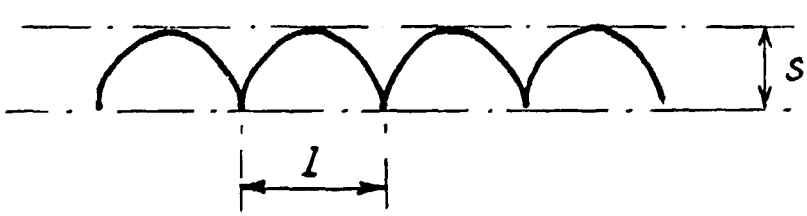
SCALE	DATE	SIGN	REV. A	B

Appendix No. 7

Appendix No. 8.

TESTS OF LIVE RINGS MIGRATIONS AND CLEARANCES TARTOUS I AND II.

Time of test		August 1989		November 1989	
Kiln no.	Support no.	Migration l. mm	Clearance s. mm	Migration l. mm	Clearance s. mm
1	I	46	23	16	9
	II	25	14	*	*
	III	13	8	*	*
2	I	50	25	*	*
	II	12	8	*	*
	III	15	8	*	*
3	I	48	24	10	8-6
	II	12	8	*	*
	III	10	6	*	*
4	I	28	13	11	8-2
	II	7	2	*	*
	III	12	5	*	*



Appendix No. 9.

TESTS OF KILN ROLLERS INCLINATIONS
TARTOUS II / KILN No. 4.

Kiln inclination H= 3.0% (designed).

Kiln support and Roller	Reading at Inclinometer		Inclination measured	Deviation of Inclination	Distance of Bearings	Correction calculated	Comments
	Up RHo	Down RHi	RH %	h %	A mm	t	
I							
Left	709	1306	2,99	0,01	2150	0,20	OK
Right	703	1307	3,02	0,02		0,40	OK
II							
Left	692	1306	3,07	0,07	2150	1,40	*
Right	696	1309	3,07	0,07		1,40	*
III							
Left	704	1314	3,05	0,05	2150	1,00	*
Right	696	1302	3,03	0,03		0,60	*

Measured inclination $RH = \frac{RHi - RHo}{2}$

Deviation of inclination $h = RH - H$

Distance between rollerbearings (same roller)

Correction calculated $t = \frac{A \times h}{100}$

Appendix No. 10.

TARTOUS Cement Co.

GEOLOGICAL EXPLORATION REPORT. (1978)
BY: VEB / SKET. DDR.

Quote.Summary

The present final report deals with the results of geological exploration executed for cement raw materials as limestone and basalt in Tartous area. The limestone deposit, divided into three adjoining deposit parts and one additional reserve field, is represented by a stratigraphic sequence of Upper Cretaceous series (Upper Cenomanian, Turonian, Senonian).
The limestone deposit parts are characterised by a great workable thickness from about 70 to 90 m, respectively.

The basalt deposit is to classify stratigraphically to the lower pliocene. The average of the workable thickness amounts to 50 m. The deposits are located approximately 1.3 km North of the plant side Tartous, at the Western margin of the Ansariyeh mountain side.

-Limestone deposit parts are situated at the slops of the E-W running dry river bed.
-Basalt deposit follows directly South of the limestone deposit part II.

The explored areas were investigated by geological detailed mapping and exploration openings. The drilling operations were executed in the following scope:

- Limestone deposit:	48 borings	totalling	4,833.5 m
- basalt deposit :	15 borings	totalling	916.5 m
		TOTAL	5,750.5 m

The density of the exploration openings was fixed under consideration of the variability of geological parameters. The vertical and horizontal extension of the workable horizons as well as the chemical composition of the raw materials were clarified for the deposits.

As results of exploration works workable reserves of raw materials were proved in the following quatities refered to dry materials:

144.1 million tons limestone
35.3 million tons basalt

The explored reserves of limestone and basalt are sufficient for a production of more than 40 years.

The chemical composition of raw materials was determined by 940 detailed analyses. The correction / correctness of analysesresults was proved by 163 check analyses (local check analyses and check analyses made by independent laboratory). The content of harmful admixtures as Mgo, SO3, K20, Na20 and CL- do not exceed the given limits. The quality of the raw materials corresponds with the given conditions.

According to the industrial evaluation of the raw materials executed in the laboratory of VEB SKET/ZAB Dessau the mixture of raw material will be composed of three components, whose proportions can vary within following limits:

Limestone	75 - 78 %
Basalt	15 - 22 %
Sand	2.5 - 7 %

Unquote.