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(R) THE ARAB CEMENT COMPANY  
DERUDEH CEMENT PROJECT  
THE SUDAN

Prepared for the Government of the Sudan  
by the United Nations Industrial Development Organization

Based on the work of M.A. Basman, consultant, and  
the UNIDO Investment Co-operative Programme

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## ABBREVIATIONS

nty - metric tons per year

1. INTRODUCTION

This report is based upon the findings of Mr. M.A. Basman, consultant, who visited Sudan from 13 to 17 March 1978. Mr. Basman was under contract to UNIDO's Investment Co-operative Programme Office, which had been requested by the Sudanese Government to assist in evaluating proposals for the construction of a new cement plant at Derudeb. The report is a revised version of a draft submitted by Mr. Basman following his field work.

2. SUMMARY

The purposes of the mission were:

- a. to compare and evaluate the offers received by the Government of Sudan regarding the construction of a new cement plant at Derudeb, and
- b. to identify projects for technical assistance.

For the purpose of the above, a study was made of the proposals for construction and partnership already received by the Arab Cement Company (the Company) along with other pertinent documents. In addition, meetings were held with the Arab Cement Company's Board of Directors.

Though a review of the existing state of the Sudanese cement industry was not included in the terms of reference, it was undertaken on general terms in order to identify problems within the industry as well as those arising from general economic conditions within the country. The review was also undertaken for the purpose of identifying technical assistance programmes aimed at improving existing facilities.

Recommendations are to proceed with implementation of the new Derudeb Cement project while simultaneously undertaking to improve the operations of the two existing cement plants. A review of the proposals already received from four foreign firms and consortia shows that further information is required from each bidder before a meaningful comparison of these proposals can be made. In any case, the existing feasibility report must be completed before any definitive action can be taken. As detailed in the body of the report, a substantial amount of technical assistance is prescribed for implementing the Derudeb project as well as for improving the performance of the existing cement plants.

3. PRODUCTION OF CEMENT IN SUDAN

The establishment of a cement industry in the Sudan dates back to the days of British colonial rule. At present there are two cement plants with a total production capacity of 335,000 mty. These are the Atbara and Rabak cement plants, descriptions of which are as follows:

- a. The Atbara Cement Plant: This plant is located near the town of Atbara, on the east bank of the Nile, about 300 km. north of Khartoum. Its rated capacity is 225,000 mty.

The Atbara plant started production in 1927 under the name of Maspio Cement Corporation with a dry-process, reconditioned kiln having a daily output of 150 metric tons of clinker. The kiln was purchased as used from Ethiopia. In 1946, a new dry-process kiln, supplied by F.L. Smidth and Co. of Denmark, was added. It has a daily capacity of 570 metric tons of clinker. The Maspio Cement Corporation was nationalized following Sudanese independence in 1956.

At present, an expansion project consisting of a new dry-process kiln with a daily capacity of 750 metric tons of clinker is under way. This new unit is expected to be commissioned in the first quarter of 1979 and will in effect double the existing capacity. It is being supplied by F.L. Smidth and Co. of Denmark under a loan from the Danish Government.

- b. The Rabak Cement Plant: This plant is located on the east bank of the Nile, close to the town of Kosti, about 250 km. south of Khartoum. Its rated capacity is 110,000 mty. It was constructed in 1970 and is also owned by the Sudanese Government. Production is from a dry-process kiln having a daily capacity of 350 metric tons of clinker. The project was financed by a loan from the Yugoslav Government, which also supplied the equipment.

Output and capacity utilization of the two cement plants for the last three years are as follows:

TABLE 1 - SUDAN: Output and Utilization of Existing Cement Plants  
(Thousands of metric tons)

PLANT	RATED ANNUAL CAPACITY	1975 PRODUCTION/ UTILIZATION	1976 PRODUCTION/ UTILIZATION	1977 PRODUCTION/ UTILIZATION
ATBARA	225	147 / 0.65	129 / 0.57	140 / 0.62
RABAK	110	35 / 0.31	37 / 0.37	37 / 0.37
TOTAL	335	182 / 0.54	166 / 0.49	177 / 0.52

The preceding table shows that the output of each plant is well below its rated capacity. According to the General Manager of the Atbara cement plant, this is mainly due to an irregular supply of electric power and to difficulties encountered in obtaining spare parts. It also results from problems at the Rabak clay mills and with the long rope-way across the Nile at Atbara (20 km.). These problems are in the process of being resolved.

In addition to the Atbara plant expansion and the Arab Cement Company's Derudeb project, there is another new cement project, namely the construction of a plant to produce cement from coral deposits. The latter is to be located near Port Sudan and to have a capacity of about 1 million metric tons of clinker per year. Most of its production will be exported. A feasibility study of this project is being prepared by a Belgian company.

4. THE MARKET FOR CEMENT IN SUDAN

a. Demand

There are no detailed surveys covering the demand for and consumption of cement in the Sudan. However, the feasibility study for the Derudeb project contains rough estimates of demand based on a World Bank survey of world-wide cement consumption. The World Bank data give the per capita cement consumption of a country as a function of its per capita gross domestic product. Estimates prepared on this basis and actual consumption for the past three years are as follows:

TABLE 2 - SUDAN: Projected Demand for and Actual Consumption of Cement

YEARS	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
	(Thousands of metric tons)									
Estimated Demand:	540	569	599	630	653	698	735	774	815	858
Actual Consumption:	357	261	342							

Demand in addition to the above will no doubt result from implementation of the Government's new 6-Year Development Programme amounting to 2.5 billion Sudanese Pounds (US\$ 1.0 billion equivalent). Assuming that 5 percent of that amount represents the value of cement to be used during implementation, the additional demand will probably be around 100,000 mty.

b. Supply

Sources of supply for cement over the last three years have been as follows:

TABLE 3 - SUDAN: Supply of Cement

SOURCE	1975	1976	1977
	(Thousands of metric tons)		
Production in two existing plants	182	166	177
Official imports	65	65	65
Estimated null value imports <sup>1/</sup>	10	30	100
Total	357	261	342

<sup>1/</sup> Sudanese labourers working abroad are allowed to import cement with their hard currency savings. This cement is officially registered as "null value imports".



The shortage of cement in respect to estimated demand is mainly due to under-utilization of the existing plants but also due to Government restrictions on imports as a result of hard currency constraints. It should be noted that the annual cement consumption of Sudan has thus far been roughly equivalent to the rated production capacity of the existing plants.

Estimated future demand as related to capacity of domestic plants is shown in Table 4. The surplus forecast for 1983 and 1984 is only in terms of capacity. As shown in Table 1, under-utilization of the existing plants has been a serious problem in recent years.

TABLE 4 - SUDAN: Estimates of Demand vs. Domestic Capacity

YEARS	1978	1979	1980	1981	1982	1983	1984
	(Thousands of metric tons)						
Estimated Demand: <sup>1/</sup>	730	753	798	835	874	915	958
Rated Capacity:		<sup>2/</sup>	<sup>3/</sup>				
Atbara	225	394	450	450	450	450	450
Rabak	110	110	110	110	110	110	110
Derudeb	-	-	-	-	<u>250</u>	<u>500</u>	<u>500</u>
Total	335	504	560	560	810	1,060	1,060

<sup>1/</sup> Includes 100,000 mty additional demand created by implementation of 6-year plan 1977-1983.

<sup>2/</sup> Includes new kiln commissioned April 1, 1979.

<sup>3/</sup> Includes new kiln at full capacity.

<sup>4/</sup> Assumes Derudeb plant is commissioned mid-1982.

c. Prices

The present official price of cement in Khartoum is US\$ 100 per metric ton. The c.i.f. Port-Sudan price for imported cement is around US\$ 60 per metric ton, and the ex-factory prices of the cement produced at the Atbara and Rabak plants are US\$ 37 and US\$ 34 per metric ton respectively. The black market price for cement in Khartoum has been known to be as high as US\$ 250 per metric ton, reflecting the extent of the shortage.

The disparity in prices is also the result of exorbitant road transportation costs. Though rail transportation in the Sudan is cheaper than road, cement is usually transported by road, particularly between Port-Sudan and Khartoum. This is due to the limited capacity of the Sudanese railway system, which consists of one narrow gauge track.

5. THE COMPANY AND PROJECT

The Arab Cement Company was established in 1976 by agreement between the Government of the Sudan and private interests in Kuwait. The agreement foresaw the establishment of a cement plant of 500,000 mty capacity at Derudeb in the Red Sea District. Derudeb is a small town on the Port Sudan - Kassala railroad, about 300 km. from Port Sudan. The plant is to be located near limestone deposits about 20 km. east of Derudeb.

For the sake of greater flexibility in management, the Arab Cement Company was formed as a private company under the Sudanese Companies Ordinance of 1925, with shares held by the Government. Control is vested in a Board of Directors appointed by the Government.

According to the agreement, the Kuwaiti partner incurred the obligations to carry out all studies and works required for implementing the project, to finance all the hard currency needs, and to provide all managerial and technical personnel for the Company. He also agreed to subscribe to 50 percent of the equity. The Kuwaiti partner engaged an Argentine consulting firm, Franklin Consult and Obrelmec S.A., to prepare a feasibility study for the Derudeb plant, but failed to fulfil his commitments concerning the financing of the project. Consequently, the Arab Cement Company decided to seek financial assistance elsewhere. Thus far four proposals for financial assistance and/or investment have been submitted to the Company, and several more are expected to be received in the coming months.

The Company is encountering difficulties in comparing and evaluating the proposals for financial assistance as well as in negotiating with firms which have submitted proposals. This is due mainly to a lack of technical capability on the part of the Company. The only engineer available to the Company is the General Manager of the Atbara cement plant, who has been appointed by the Government to the Board of Directors of the Arab Cement Company. Being aware of the technical difficulties that it will encounter during the implementation of the project, the Company has requested technical assistance from UNIDO.

An additional problem at present is the fact that the Company has access to only part of the feasibility study carried out by the Argentine consulting firm. Geological reports, equipment specifications, and a financial analysis of the project are still missing, because the consulting firm, not having been paid by the Kuwaiti partner, refuses to supply these sections of the feasibility study. The Arab Cement Company intends to negotiate directly with the consulting firm in order to obtain the missing information.

6. COMPARISON AND EVALUATION OF PROPOSALS

At the time of the mission, the Arab Cement Company had already received four acceptable proposals from foreign firms to construct the plant on a turnkey basis. These proposals include financing.

The firms are:

- a) A joint venture of:  
Coutinho Caro and Co., Federal Republic of Germany, and  
Polysius GmbH, Federal Republic of Germany
- b) A joint venture of:  
Eisen-Bau-Essen, Federal Republic of Germany, and  
VOEST-Alpine, Austria
- c) SNC Consultants, Canada
- d) GKN Contractors Ltd., United Kingdom (subsequently withdrawn).

The Arab Cement Company received a fifth offer from Technip-France, but this did not include financing and therefore has not been taken into consideration.

During the coming months, the Arab Cement Company expects to receive additional proposals from:

- a) Mitsubishi, Japan
- b) Hondai, Republic of Korea
- c) a Yugoslav state organization.

All proposals are based on the existing feasibility study prepared by the Argentine consulting firm, on the criteria laid down by the Arab Cement Company for the establishment of a new cement plant at Derudeb, and on the Company's guidelines concerning shipping, local contractors, climatic conditions, water supply, fuel prices, charges and duties etc. The Company's criteria are: (1) that the finance to be provided by the foreign firms must cover the hard currency component of the project, (2) that the Government equity in the Company must be in local currency, and (3) that the equity of the foreign partner must not exceed 49 percent.

Inasmuch as the feasibility study prepared by the Argentine consulting firm does not contain detailed equipment specifications, and since the criteria of the Arab Cement Company do not prescribe a financial plan for the project, the proposals thus far submitted lack important details in these respects. Specifically, some of these missing details

are: (1) performance guarantees for the main equipment in respect to characteristics of the material to be processed, (2) the overall electric and calorific consumption per ton of cement produced, (3) the weight of the equipment, (4) the detailed prices of the equipment, and (5) the proposed degree of equity participation of the foreign partner.

The proposals differ from each other according to the different qualifications and experience of the proposing firms and/or joint ventures. A comparison of proposals is given in Annexes 1 and 2 of this report. Annex 1 shows the costs involved in three of the proposals and also the proposed financial plans. Annex 2 contains comments on the technical specifications of the equipment, which is the most important component of the project from a technical as well as cost point of view.

Annex 1 shows that the cost break-downs consist mainly of aggregate sums, and that they are prepared on different bases. It also indicates that the financial plans are not yet clearly defined. The proposals stipulate that the financing of the project must be negotiated. It can be concluded from Annex 1 that the SNC proposal is the more favourable in terms of cost and in respect to details concerning the over-all implementation of the project.

From Annex 2 it can be concluded that the proposal from Coutinho Caro and Co. / Polysius GmbH is preferable in terms of technical specifications. Only two of the proposals, those of Coutinho Caro and Co. / Polysius GmbH and EBE/VOEST-Alpine, are comparable from a technical point of view. The clarity of the technical specifications provided by these groups is due to the fact that both joint ventures include as partner one well-known equipment manufacturer, namely Polysius and EBE respectively.

The proposal of GKN Ltd., which has in any case been withdrawn, lacks clarity in respect to equipment specifications but is very detailed in matters concerning the over-all implementation of the project. The reason for this contradiction is that GKN is not a cement equipment manufacturer but rather a civil engineering contractor. It therefore would have to subcontract the purchase of equipment from cement equipment manufacturers.

The proposal of SNC is very detailed on matters concerning overall implementation of the project. Furthermore, it provides greater detail than do the others on the subject of equipment guarantees as well as on receiving procedures. On the other hand, this proposal provides only a brief description of the equipment rather than detailed specifications. This is due to the fact that SNC is neither a cement equipment manufacturer nor a contractor, but rather a consulting company specialized in implementing large industrial projects including cement plants. This is also reflected in SNC's financial plan, which specifies a loan from the Canadian Export Development Corporation. The latter requires that all equipment be procured from Canadian cement equipment manufacturers by means of competitive bidding.

From all of the above it may be concluded that, in their existing states, the proposals do not lend themselves readily to a comparison and evaluation of their technical and financial aspects. Meaningful comparisons may be made only after further elaboration by the proponents.

7. RECOMMENDATIONS

In order to satisfy the cement requirements of the country, it is recommended that the Government of the Sudan take the following action: (1) proceed with financing and implementing the new Derudeb cement project, and (2) undertake improvement of the existing cement plants in order to achieve operation at full rated capacity.

a. Derudeb cement project

The first step in implementing the Derudeb cement project should be to complete the existing feasibility study, and for this purpose financial assistance may be required. Following this, the Arab Cement Company should act in accordance with one of the following alternatives:

First Alternative: Obtaining financing, including equity participation, from international finance organizations and banks. The steps to be followed are:

- 1) A consulting firm should be employed to review and update the existing studies and to undertake any other studies deemed necessary for establishing the techno-economic feasibility of the project. Such studies should embrace the cement market, supply of raw materials, and detailed investment and operational cost estimates including infrastructure and financial charges.
- 2) The consulting firm should then prepare the technical specifications and bidding documents, following careful study of local requirements and conditions.
- 3) The Company should apply to international financing organizations for assistance in order to complete the financial plan.
- 4) The Company and the consulting firm together should organize the bidding and awarding of contracts.
- 5) The consulting firm should assist the Company during the implementation of the project and the commissioning of the plant.
- 6) The consulting firm should organize training programmes for the managerial and technical staffs of the Company, and should assist the Company in the management of the plant.

Technical assistance corresponding to the steps involved in the first alternative is proposed along the following lines:

- i) During the selection of the consulting company:
  - One Cement Consultant 1 man/month
  - 1 journey
- ii) During the appraisal of the techno-economic feasibility study:
  - One Economist/financial analyst 1 man/month
  - One Chemist, or Geologist 1 man/month
  - One Cement Consultant 1 man/month
  - 2 journeys
- iii) During the evaluation of bidders:
  - One Economist/financial analyst 1 man/month
  - One Cement Consultant 1 man/month
  - 1 journey
- iv) During the commissioning of the plant:
  - One Cement Consultant 2 man/months
  - 1 journey

Total: 8 man/months and 5 journeys

Second Alternative: Seeking suppliers' credits and supplier equity participation. The steps to be followed under this alternative are:

- 1) Major decisions should be made by the Company regarding plant location, capacity, type of process, and degree of labour intensity desired.
- 2) The Company should request offers from manufacturers of cement production equipment on a turnkey basis including financing.
- 3) The Company should negotiate with equipment suppliers for the purpose of forming a joint venture as well as for selecting one of them as the sole contractor for the project.
- 4) The Company should hire a consulting firm, approved by the contractor, for co-ordinating and supervising the implementation of the project.
- 5) The consulting firm should assist the Company in the commissioning of the plant as well as in its management.



Technical assistance corresponding to the steps involved in the second alternative is proposed as follows:

- i) During the selection of a contractor:
  - One Economist/financial analyst 1 man/month
  - One Cement Consultant 1 man/month
  - 2 journeys
- ii) During the commissioning of the plant:
  - One Cement Consultant 2 man/months
  - 1 journey

Total: 4 man/months and 3 journeys

The first alternative, which is usually used in the implementation of large industrial projects, is a longer process than the one involved in the second approach; however it is more certain and cheaper when the results are considered, i.e. better loan terms, better contract conditions, plus a tailoring of the plant to suit the industrial and economic conditions of the country. This is the approach that SNC is proposing.

The second alternative, which is usually employed in the implementation of medium and small industrial projects in the private sector as well as in their expansion (e.g. Pabak and Atbara projects), is simple and relatively short. However, results depend on the qualifications, experience and reputation of the cement equipment manufacturing company, or joint venture partner as the case may be. This is the approach that Coutinho Caro and Co./Polysius, and Eisen-Bau-Essen/VOEST-Alpine are proposing.

Third Alternative: A third alternative would be a combination of alternatives one and two. It would be possible and even desirable to seek financial assistance from an international institution, and credits as well as equity participation from suppliers at the same time.

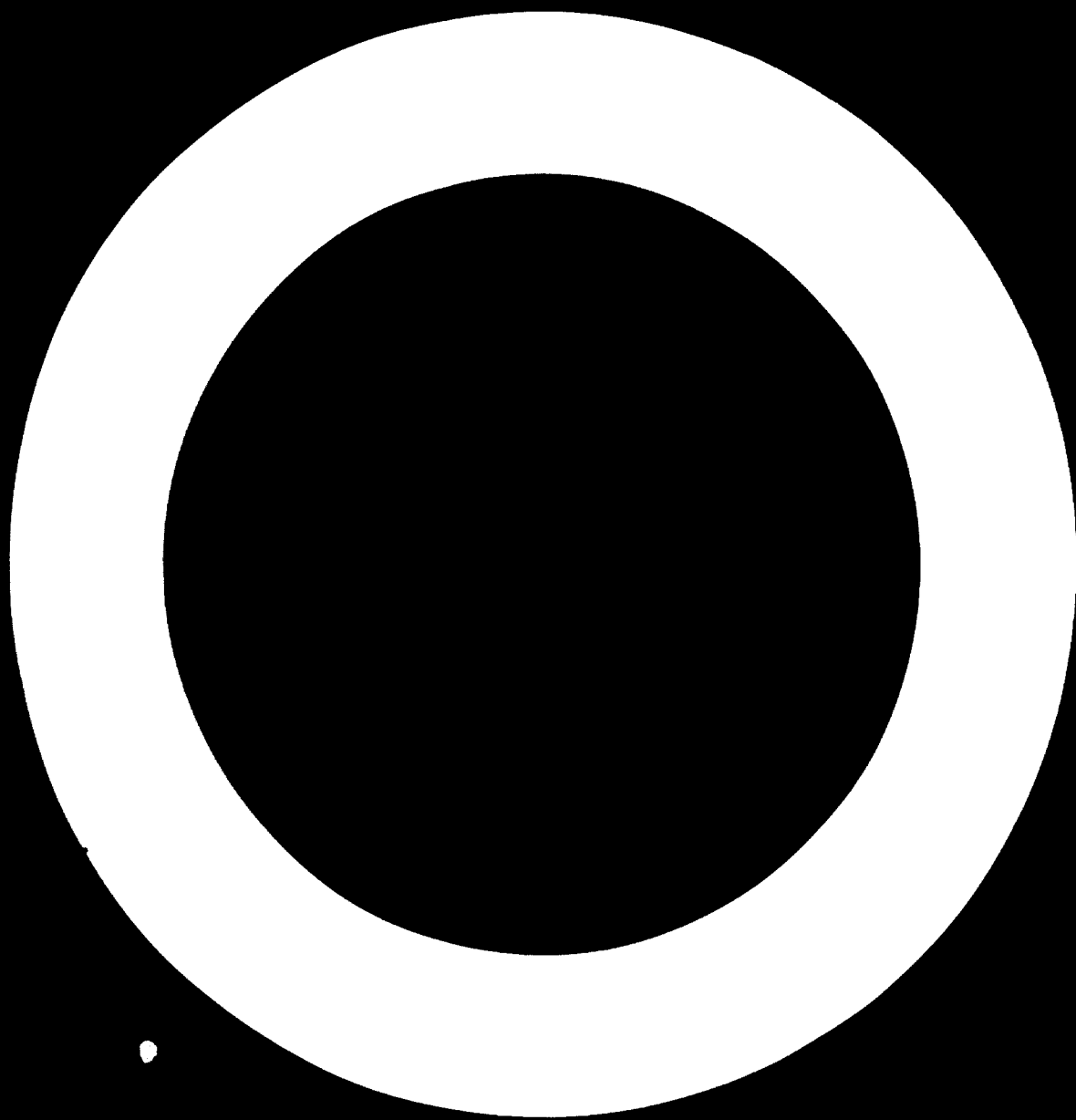
It is suggested that special training abroad be provided for the technical and managerial staff of the Arab Cement Company. Proposed personnel and training time involved in other countries are as follows:

<u>Personnel</u>	<u>Duration</u>
- Works Manager	6 months
- Chemical Engineer	4 months
- Maintenance Engineer	6 months
- Production Engineer	6 months
<u>Total:</u>	22 man/months and 4 journeys

b. Existing cement plants

In respect to improving the performance of the existing cement plants, it is proposed that technical assistance be provided to the two firms. The following expertise is recommended:

<u>Personnel</u>	<u>Duration</u>
- One Cement Plant Maintenance Expert	12 months
- One Cement Plant Production Expert	12 months
<u>Total:</u> 24 man/months and 2 journeys	



Annex 1

SUDAN: Derweeb Cement Project  
Costs and Financing Offered - A Comparison of Proposals  
(US\$ 000)

	COSTS	SNC LTD	E B E		C C C	
			VOEST-ALPINE		POLYSIUS	
1	Consultancy Service	2,150	2,150	(1)		(1)
2	Cement Production Equipment	27,000	52,000	(1)	57,570	(1)
3	Construction Management	2,200		(1)		(1)
4	Training Personnel	1,800		(1)		(1)
5	Power Station	6,500	10,000	(1)	10,250	(1)
6	Spare-Parts	2,250		(1)		(1)
7	Freight-Insurance	2,250	3,330	(2)	8,570	(2)
8	Other Equipment	5,400		(1)		(1)
9	Erection	9,000		(1)		(1)
10	Quarry Equipment	900				
11	Civil Engineering	16,200	19,650	(1)	21,140	(1)
12	Turn-key Fees	3,040		(1)		(1)
	TOTAL	78,500	95,120		105,370	
	UNIT COST PER TON AND PER YEAR	157	190		210	
	IMPLEMENTATION TIME IN MONTHS	36	30		33	
	FINANCING OFFERED					
1	Amount of Loan	43,500 15,500		(5-7) (5-7)	50,000 10	(5-7) (5-7)
2	Period of Loan including grace period (years)	10 1-6		(3-7) (4-7)	10	(5-7) (5-7)
3	Grace Period (years)	3 -		(5-7) (4-7)	2	(5-7) (5-7)
4	Annual Interest Rate (%)	6.5 -		(3-7) (4-7)	6.5	(5-7) (5-7)
5	Anticipated Equity Participation (%)	15	10-15	(4-7) (4-7)	15	(5-7) (5-7)

- (1) Included in item (2)  
(2) Partially included in item (1)  
(3) Loan from Canadian Export Development Corporation  
(4) Loan or Equity from the Banque Arabe D'Affaires et de Finance, Paris  
(5) Loan or Equity from EBE/VOEST-ALPINE.  
(6) Loan or Equity from CCC/POLYSIUS, to be provided from different sources (Scandinavia, Federal Republic of Germany, France, Austria).

( ) To be negotiated

NOTE I : The total cost of the SNC proposal, which has been withdrawn, was US\$ 80,000,000 (US\$ 100 per ton of capacity)

NOTE II : Infrastructure, contingencies and financial charges are not included in the costs given above.

NOTE III : Costs were converted to US dollars as follows:

For SNC - Canadian \$1.00 = US\$ 0.90  
For EBE - AS 1.00 = US\$ 0.066  
For CCC - DM 1.00 = US\$ 0.476



Annex 3

SUDAN: DERUDEB CEMENT PROJECT

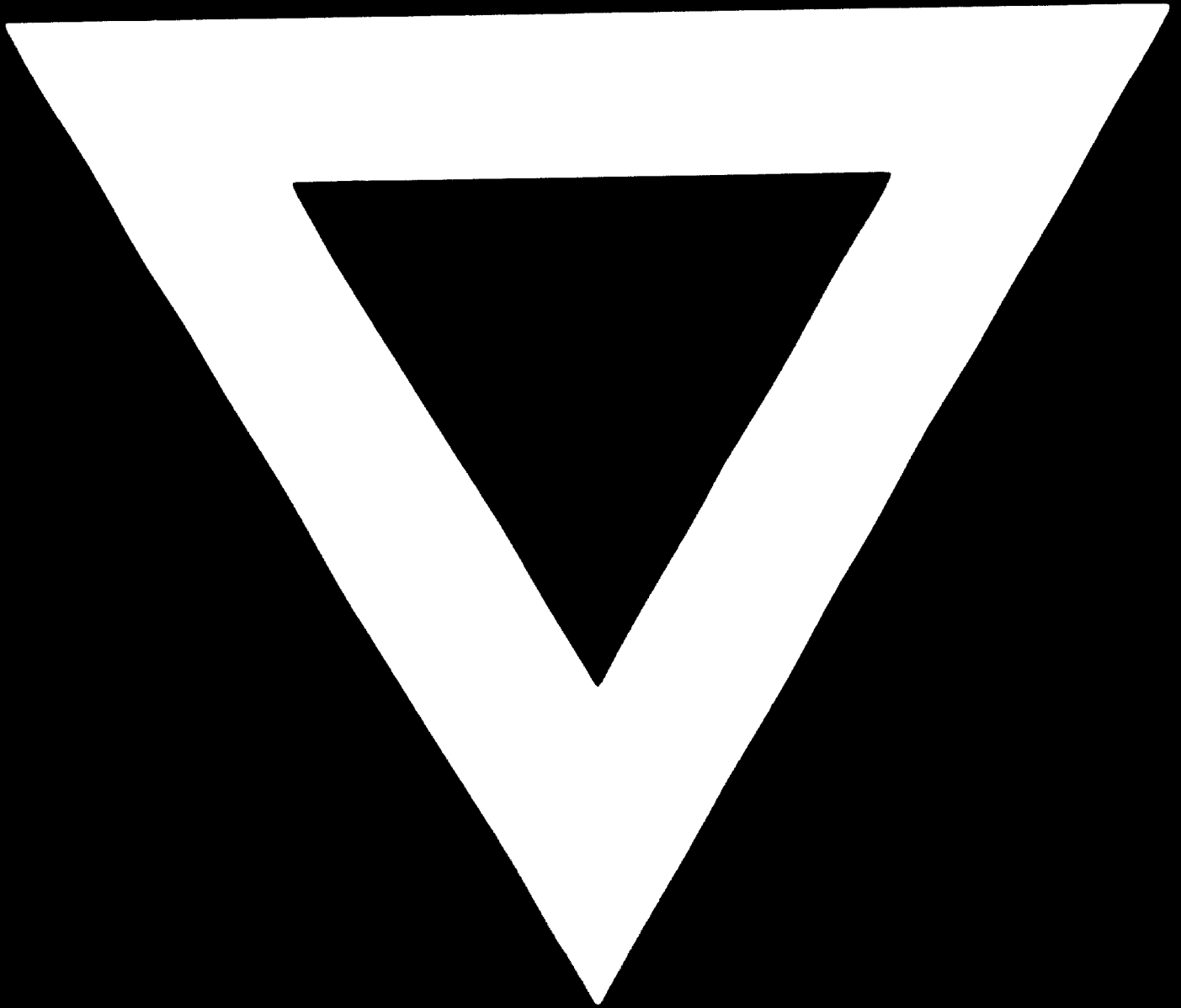
OFFICIALS MET DURING MISSION

(March 13-19, 1978)

Mr. Abdul Latif Widat Alla	Under Secretary of the Ministry of Industry
Mr. Ali Mohamet Siddik	Chairman of the Arab Cement Company
Mr. Abdulaziz Omer	Officer of the Arab Cement Company
Mr. Yousif El Zubeir	General Manager of Atbara Cement Plant
Mr. Michail Hyland	UNDP Deputy Resident Representative
Mr. Peter Quennel	UNDP Assistant Resident Representative



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