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中国科学院植物研究所

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**REPORT ON
PROJECT FINDING MISSION TO
THE DEMOCRATIC REPUBLIC OF THE SUDAN**

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March 1979

Japan International Cooperation Agency

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PREFACE

With a view to identify suitable projects for Japan's official economic and technical assistance to the Democratic Republic of the Sudan, a Project Finding Mission was sent to the country by the Japan International Cooperation Agency in November 1978. After exchanging views of mutual interest with the responsible governmental agencies including the Ministry of National Planning, the Mission came to believe that the Sudanese Government accorded top priority to: (1) commodity aid; (2) electric power generation; (3) production of construction materials; (4) development of agriculture; and (5) construction of roads.

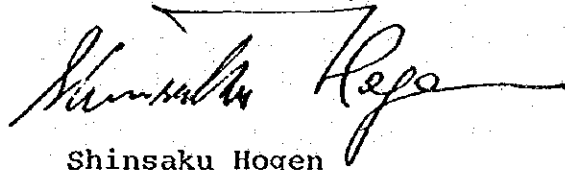
Of the afore-mentioned proposed projects, the Agency has already made feasibility studies on projects for the development of agriculture and the construction of roads, the Mission therefore has focused its attention on preliminary surveys on the electric power generation and the production of construction materials.

In this report, an outline of the country's recent economic and social development is introduced first; second, the proposed projects on which the Sudanese Government puts emphasis are briefly described, and finally the proposed power and cement projects are analyzed in some depth based on the Mission's findings. Those who are interested into the details of the agriculture and road projects are requested to refer to the reports prepared and submitted to the Sudanese Government by the Agency.

In addition, in considering assistance to the Democratic Republic of the Sudan for suitable projects to be made jointly between the Kingdom of Saudi Arabia and Japan, the Agency believes that this report provides useful information with regard to the development program of the Sudanese Government,

the Government's highest priority fields and the proposed concrete projects, together with the Agency's above-mentioned reports on the development of agriculture and the construction of roads.

March, 1979

A handwritten signature in cursive script, appearing to read 'Shinsaku Hogen', with a horizontal line extending from the end of the signature.

Shinsaku Hogen

President

Japan International Cooperation Agency



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Part I: The Country's Economy

1. General

Since the collection and processing of the various statistical data in Sudan leave much to be desired, utmost care is necessary in using them. Specifically, the national accounts statistics are not free from a number of unsatisfactory factors and in recognition of this fact, efforts are currently being made by the Sudanese Government to revise them. From the production statistics and other data it seems likely that the Sudanese economy in the 1970's has achieved a real growth rate of a little higher than 4%, or per capita growth of about 1%.

At least 3/4 of the working population depend on agriculture for their livelihood if the nomads were included and agriculture contributes more 40% of the country's GDP. Also, nearly all sources of the country's foreign exchange earnings depend upon the export of agricultural products; in particular, raw cotton is an important export item, accounting for nearly half of the total exports. The manufacturing industry consists mostly of the processing of farm products, such as the food processing, textile, leather, wood-working, etc. In short, Sudan is a typical agricultural country whose heavy industries are still in early stage of development. A household expenditure survey indicates that the Engel's coefficient is exceedingly high, over 70% of total household expenditures, suggesting that very little surplus is left to spend for manufactured goods. The country's industrialization is restrained not only by its small domestic demand for industrial products but also by its sparsely populated vast territory. The underdeveloped infrastructure, such as the transportation facilities, power generation, etc. are also hampering the development of its manufacturing sector.

Since the end of the civil war in 1972 efforts have been initiated by the Sudanese Government for the economic development and as a result both ordinary and development public expenditures increased rapidly. Because the revenue has not grown keeping pace with the increase in the expenditure, the budgetary deficit went up to reach almost 10% of the GDP. In order to finance this deficit the Government had to resort to external loans and to borrowings from domestic banks. The resulting increase in money supply has led to inflation on the one hand and stimulated import on the other, deteriorating the country's balance of international payments, which was further aggravated by the oil crisis. In addition, deficit financing for several public entities has contributed to the budgetary deterioration.

In order to cope with the situation the Government was successful in negotiating credit facilities with I.M.F. and since fiscal 1978/79, a stabilization program has been launched including the following policy measures:

- (1) Devaluation of its official foreign exchange rate;
- (2) Limitation on inducement of short-term foreign capital;
- (3) Improvement of financial positions of public corporations;
- (4) Fixing of limit on bank credit for financing budgetary deficit;
- (5) Limitations on bank loans to the private sector;
- (6) 10% outright reduction of ordinary expenditure; and
- (7) Measures for consolidating development expenditures which include:
 - a) Intensified control over execution of development budget.
 - b) Inhibition to initiate new projects during fiscal 1978/79.
 - c) Limitations on expenditures in local cost financing.

In formulating an assistance program for Sudan, and bearing in mind various constraints stated above, if efforts were to be directed at the development of its manufacturing industry, it should be based on the development of the country's agriculture as manifested by Sudan's current Six-Year Economic Development Plan. The agricultural productivity should first be improved and then conditions should be created for its manufacturing industry, which yields higher values added than agriculture, to gradually absorb domestic demand and labor. There are two types of manufacturing industries that are related to agriculture. One type is the processing industry which utilizes farm products as raw materials. The food processing, textile, leather, and woodworking industries, which are comparatively well-developed in Sudan, are representative of this type. The other type of industry is one for supplying agriculture with inputs such as agricultural tools, agricultural chemicals, fertilizers, etc. This type of industry is still not developed in Sudan. Unless this type of industry is well-developed, the enhancement of the agricultural productivity cannot be achieved.

2. On-going Six-Year Economic Development Plan

The on-going Six-Year Economic Development Plan (fiscal 1977/78 through 1982/83), which was started on July 1 1977, includes various noteworthy features. First, the target growth rate of the agricultural sector, which was likely to be over-ambitious in the past has been reduced to a more realistic rate of 6.5%. The target growth rate of the industrial sector is 9.5%, the same as that of the former development plans. The target growth rates set for various industries are as follows: 9.0% for the construction industry; 8.0% respectively for the water, electricity, commerce, banking, real estate; 7.5% for governmental services and others; and 7.5% in real terms for the economy as a whole.

The second point worth noting is the substantially improved investment climate to an extent beyond comparison with that during the previous two plans. This is due to the fact that the current plan has been formulated on the basis of a long-term strategy to make Sudan a food supply base for the other Arab nations as part of an Arab economic integration. In 1976, the Arab Fund for Economic Development composed of the thirteen Arab States (Algeria, Egypt, Iraq, Kuwait, Lybia, Moritania, Morocco, Qatar, Saudi Arabia, Somalia, Sudan, Syria, and the United Arab Emirates) formulated a Basic Program for Agricultural Development in Sudan. This Basic Plan aims at the establishment of balanced development between the modern and the traditional sectors by the promotion of the country's traditional agricultural sector together with rural industries and thereby to achieve the correction of regional disparities. This Plan also includes a comprehensive investment program formulated in such a way that the development of necessary infrastructure is synchronized with the start of production of the various proposed agricultural and industrial projects. This Basic Plan contains 100 different projects with the total investment amounts to S£2,280 million (equivalent to 5,717.5 million US dollars) The 100 proposals are itemized as follows:

	Number of projects	Amount (in million Sudanese pounds)
(1) Modernization of traditional agricultural sector and promotion of rural industries of farming villages	25	573
(2) Private investment in joint ventures with Sudan	31	1,043
(3) Infrastructure development and others	44	671

The project proposals included in this Basic Plan are divided into two categories according to their order of priority. 61 projects totalling S£778 million are classified as Category I, and are incorporated in the current Six-Year Plan. To implement the various proposed projects under this Plan the establishment of an agency was recommended, and subsequently the Arab Authority for Investment & Agricultural Development (AAIAD) was created. The agency's headquarters was established in Khartoum in October 1976 after the formal signing of an agreement by the member nations at Rabat in April of the same year.

One fact which had a significant effect on the formulation of the "Basic Program for Agricultural Development in Sudan" and, hence on the substance of the current Six-Year Plan, was a report prepared by ILO in 1974 titled "Growth, Employment and Equity - Comprehensive Strategy for the Sudan". This report covers a wide range of subjects consisting of traffic, communication, labor, market policy, administration, trade, aid in capital, welfare, vocational education and development of Southern Region. A notable feature of this report is that it recognized the vitality of the traditional

sector which has often been ignored as a backward sector and recommended its effective utilization. The report noted that ground nuts, vegetables and other foodstuffs, whose production has increased remarkably in recent years, are produced by the traditional small farmers, and pointed out that this increase in production was the result of the completion of the railway extension from El Obeid to Nyala in the early part of the 1960s. In terms of future development strategy, the report recommended that rather than simply expanding the irrigated areas, efforts should be made to improve the yield per unit area within the areas covered by the existing agricultural programs. With respect to transport, the report recommended that the trunk roads and river transport routes be extended to the Southern Region and other parts and that feeder roads be constructed to connect remote areas to the central market with the same order of priority as the improvement of railway facilities. As for vocational training, the report asserted that efforts should not be directed at simply at increasing the number of secondary-level training schools but also at emphasizing on-the-job training within the industries. Although the report includes some recommendations which tend towards the redundant, such as the creation of a new Ministry of Rural Development whose functions would duplicate with those of the existing Ministry of Agriculture, this report as a whole should be recognized as representing a radical departure in recommending a reassessment of the past development policies exclusively oriented toward the modern sector. Another report, which have contributed a great deal to the formulation of measures for the traffic sector in the current Six-Year Plan, is a "10-year Long-term Plan for the Transport Sector" prepared in June 1973 by Beirut-based ADAR (Association for Development of Arab Resources) financed by the Kuwait Fund. This study defines the Sudan's role within the Arab world as a supplier of agricultural products and this study projected the economic growth rate for the coming 10 years at 7 to 8%. The basic strategy of this long-term plan

is to alleviate the excessive reliance on the railway system by developing roads and other means of transportation and, in the meantime, to proceed with the modernization program for the railway system itself. Many of the measures proposed in this plan had already been adopted and initiated prior to the start of the current Six-Year Plan and have been continued into the current plan period.

The total investment costs required to implement the current Six-Year Plan amounts to S£2,670 million of which S£1,570 million is to come from public investment and the remaining S£1,100 million are expected to be met by the private sector. As for the source of the funds for the public investment: 53%, or S£835 million will depend upon the foreign sources; 28%, or S£735 million will be met by the government's budgetary surplus; and the remaining S£285 million is to be covered by deficit financing from the Central Bank. According to the Economic Survey of 1977, of the share of the fund that is to come from foreign sources, the following amounts have been reportedly secured or likely to be secured:

<u>Item</u>	<u>Amount</u> <u>(million Sudan Pounds)</u>
(1) Loans, grants, etc., on which official agreements have already been concluded	180
(2) Those on which conclusions of official agreements are almost certain to take place	96
(3) Those on which possibility of concluding official agreements is high	40
(4) Those which AAIAD has agreed to finance	240

The allocation of public investment by sectors is as follows:

<u>Sector</u>	(Unit: million Sudan Pounds)		
	<u>Matter in Progress</u>	<u>New matter</u>	<u>Total</u>
Agriculture and irrigation	90	335	425 (27%)
Mining, manufacturing, electric power and tourism	160	175	335 (21%)
Transport	90	230	320 (21%)
Public welfare and administration	30	235	265 (17%)
(Reserve)*	-	225	225 (14%)
Total	370	1,200	1,570 (100%)

Note: Out of the reserve fund, S£180 million has been appropriate for the special Southern Region development program.

The allocation of private investment by sector is expected as follows:

<u>Sector</u>	(Unit: million Sudan Pounds)		
	<u>Semi-private sector*</u>	<u>Private sector</u>	<u>Total</u>
Agriculture	250	40	290 (27%)
Industry	120	80	200 (18%)
Transport	50	130	180 (16%)
Public welfare (mainly housing)	-	430	430 (39%)
Total	420	680	1,100 (100%)

Note: Includes joint financing by the Sudanese government, AAIAD and the private sector.

Part II: Proposed Projects for Roads, Agriculture and Port

As stated in the Preface, of the projects requested by the Sudanese Government, feasibility studies on agriculture and roads have already been made by the Japan international Cooperation Agency, the outline of which may be summarized as follows (for details refer to the Agency's reports):

1. Proposed Rice Cultivation Project

Location

The proposed project area is located on the left bank of the White Nile 200 km to the south of Khartoum, and about 40 km to the south of Ed Dueim, the capital of the White Nile Province.

Objective

The objective of this project is to achieve a double cropping of rice by providing embankment and drainage canals to protect the project area against inundation.

Background

Japan has provided Sudan with technical assistance grants (totalling about 500 million yen) since fiscal 1977 to construct a pilot farm (including accessory buildings and farming appliances) of 50 ha, on which experimental cultivation is currently being conducted. Feasibility studies were made during the period between May and August 1977.

Estimated Cost

A total construction cost is estimated at US\$210,760,000 (1977 prices), of which foreign exchange portion would be 55%, for converting the Moorland of 15,000 ha into rice fields in

the Abu Gasaba Basin and for providing facilities for processing farm products.

Internal rate of return

If a yield of ten tons per ha is reached, the internal rate of return is estimated to be 17.6%.

Benefits and Justification

Despite the fact that Sudan is a typical agricultural country and is expected to be a food supplying base for the Arab nations, its import amount of foodstuffs, such as sugar, tea, wheat, etc., accounts for more than 10% of the total imports. Demand for rice is well over the domestic production and the shortage reaching 10,000 tons a year is being met by imports from Egypt and other countries. The rice-producing areas in Sudan include Gezira, Bahr El Ghazal, and Equatoria districts, whose yearly output are no more than 12,000 tons. Even in the Gezira area where the yield is the highest, the average yield is as low as 1.55 ton/ha.

The purpose of the proposed project is to increase the average yield substantially and make possible double cropping by introducing pump irrigation and re-use of drain water through the provision of drainage canals. If this project is initiated as scheduled, the output is expected to reach 140,000 tons (99,000 tons in terms of milled rice) in nine years, at that time not only can the self-sufficiency in rice be achieved but also the export of surplus rice would be made possible. Moreover, if the straw, which is a by-product, is used as the feedstuff for domestic animals, it is expected to increase the quality and quantity of feedstuff, and thus contributing to the improvement of the quality of livestock raising in the country. Also, it is expected that new rice cultivation techniques may be learnt in and give an impetus to the other rice growing areas. This proposed project is included in the

on-going 6-Year Plan.

2. Proposed Road Project

Location

A road between El Obeid and Um Ruaba, the length of which is 136 km.

Objective

The objective of this road is to form a part of the Transafrican highway network which links Port Sudan with Chad via El Geneina in the western region.

Background

This was the first case of survey made under agreement concluded between the African Development Bank and Japan in October 1975 whereby Japan would provide through the Japan International Cooperation Agency technical assistance for pre-investment studies on possible projects for which the Bank might consider financing. The feasibility study on this proposed project was made during the period between March and June 1977.

Estimated cost

For the construction of the proposed DBST-paved road (6m in width) 136 km in total length, consisting of three engineering sections with thirteen reinforced concrete bridges, the total construction cost is estimated at US\$325,590 thousand (1977 prices not including taxes) of which foreign exchange component represents 62% of the total.

Internal rate of return

Under the assumption that the annual traffic volume would be growing at 7% for the period up to 1992, and then at 5% per annum, the internal rate of return is estimated at 19.1%. If the annual growth rate is assumed to be 5% over the entire period, the internal rate of return would be 16.0%.

Benefits and Justification

As of end June 1978, the country has only a little over 1,261 km of paved roads within the vast territory. In the whole country, it is estimated that there are unpaved dirt roads (tracks) totalling some 20,000 km in length, 3/4 of those become impassable during the rainy season. Accordingly, the operating cost of road transportation becomes very costly and the movement of goods is also restricted. If a proper network of roads is developed, the traditional agricultural sector will be given an impetus to produce more cash crops.

The construction of the trunk road (1,190 km in total length) which connects Port Sudan to Khartoum is presently nearing its completion and in addition the extension of the road network to the north, south, and west of this trunk road is being under study. Specifically, it is proposed that the road network, which branches off the trunk road at El Obeid be constructed to link Wau in the southern Sudan. The proposed road project is therefore indispensable for the construction of the Transafrican highway and for the development of the Southern Region, as is evidenced by the fact that this proposed project has already been incorporated in the current 6-Year Plan.

3. Proposed Port Project

In addition to the above two proposed projects, the Sudanese Government suggested that a new Suakin port project might be a candidate for the Japanese Government to consider assistance.

Location

The new Port Suakin is proposed to be built at Marsa Kuwai some 40 km down the coast south of Port Sudan. In the proposal, an inlet which is parallel to the waterfront of Marsa Kuwai is to be utilized to construct the proposed port.

Objective

In order to cope with increase in incoming and outgoing cargo during the current Six-Year Plan period, the Sudanese Government intends to proceed with the construction of the proposed new port which is incorporated in the current Plan. According to the proposal, quays will be built primarily for outgoing agricultural produce and processed products and mineral ores and products, for all of which production increases are projected by the current Six-Year Plan, together with a quay for import of petroleum products and construction materials and equipment which can also be expected to increase in future.

Back ground

In 1977, the West German consulting firm Rhein-Ruhr Ingenieur carried out a feasibility study and subsequently another West German firm, Strabag Co., submitted a detailed design with the anticipation the construction of the port itself would be financed by Saudi Arabia and that of the related substructures by West Germany.

Contents of the proposed project

The initial Rhein-Ruhr's feasibility study called for three construction stages and set 2,000 as the target year for completion. The construction works included in the first stage are as follows:

(1) Quays

Container quay:	Depth of water:	14 m
	Length:	350 m
Sugar, RORO and sundry goods:	Depth of water:	13 m
	Length:	410 m
Work vessels quay:	Depth of water:	6 m
	Length:	150 m

Container, the sugar, RORO, and sundry goods quay are to have an average width of 400 m so as to be able to provide a space for temporary container storage, an outdoor stockyard, sheds, offices, work yards, roads, transport equipment, and other necessary areas. Furthermore, considering the summer low tide level, the deck elevation is to be 2.5 m.

(2) Breakwater

(3) Reclamation

(4) Dredging of anchorage

(5) Buildings

(6) Road transportation equipment

(7) Navigation aids

(8) Roads

(9) Railroad

(10) Water supply facilities

Among the equipment that will have to be purchased during the first stage of construction are container cranes, quay cranes, a sugar cargo handling plant, mobile cranes, forklifts, etc. As for vessels, a pilot boat, three mooring boats, three tugboats, a fire boat, etc. will be needed. At completion of the first-stage, which is to last thirty-six months, the port will have an annual cargo handling capacity of 1,400 thousand tons. This will be sometime between 1981 and 1985, according to the initial plan. The timing of the second- and third-stage construction will be determined thereafter on the basis of import and export projections.

Construction cost

Strabag submitted a proposal for the first stage to the Sudanese Government on the basis of its technical review of the Rhein-Ruhr's feasibility report, together with its re-estimate of cost. The Government, however, was dissatisfied with this re-estimate and organized its own study team (headed by the Minister of National Planning) to re-examine the cost estimate of the first phase. Following are the cost estimates that have been made to date:

Rhein-Ruhr's original estimate:	100 million US dollars
Rhein-Ruhr's revised estimate:	130 "
Strabag's estimate:	200 "
Sudanese Government's estimate:	130 to 140 "

As for financing, the Sudanese Government expected that West Germany would agree to finance DM81 million for the construction.

Part III: Proposed Cement Project at Derudeb

1. The role of Cement Industry in Sudan

Among the various types of industries that are providing the agriculture of Sudan with inputs, the cement industry should deserve specific attention strategically. The importance of dam irrigation in the country's agriculture is so obvious that it does not require further elucidation. Moreover, a dam can serve multiple purposes such as power generation, water supply, fish farming, etc. Furthermore, should the country's road networks be developed, the traditional agricultural sector would be stimulated to increase its marketable products. The cement industry is indeed necessary not only for the construction of dams and roads, but also for its effect on employment of surplus labor drawn from the agricultural sector. The construction industry is the largest of all industries that can employ the unskilled labor flowing out of rural areas. From the viewpoint of the country's employment policy as well, the cement industry should be promoted in order to put the construction industry on a viable basis by providing locally available cement and secondary products. Moreover, construction works in the provinces will provide rural households with a side-job to supplement their total income. The construction industry also plays an important roll in the gross fixed capital formation, which is expected to contribute to the increase in productivity in various economic fields. If the productivity should increase, the total income of the people who are directly or indirectly involved in production would increase. An increase in income in real terms will reduce the Engel's coefficient and as a result the demand for manufactured goods will be created. If the created demand is directed toward the domestic industry, a stimulus to the domestic industry will be provided. If this series of processes should be generated in a mutually supportive

manner, it would ultimately place the Sudanese economy on a road to development. In view of the secondary and tertiary effects of increased production, increased employment and increased income, it is evident that the cement industry should receive a high priority for the country's economic development.

2. Review of Cement Industry in Sudan

The production of local cement in Sudan was first initiated by Maspio Cement Corporation, which was set up at Atbara in 1947 and started operation the following year. Another cement factory, Nile Cement Corporation, started the production of cement in 1969. Since then, the local cement has been supplied by these two entities. Both of them are public corporations supervised by the Construction Materials Corporation, but they are faced with various difficulties. The capacity of Maspio Cement was originally 150 ton/day, but it was increased to 710 ton/day in the early part of the 1950s by installing additional facilities with a capacity of 560 ton/day (capacity of 225,000 ton/year). However, the rate of this corporation's capacity utilization is very low at less than 60% and the average annual production for the last thirteen years is a little less than 130,000 tons. Major reasons for the poor performance are as follows: (i) unstable supply of electric power due to the troubles with the diesel generators and to the shortage of fuel oil; (ii) inadequate shipment of gypsum from Port Sudan; (iii) allocation of only six 30 tons freight cars daily for transporting cement products to Khartoum; and (iv) limitation of the storage capacity at no more than 1,200 tons. To solve these problems, Maspio Corp. came into a contract in 1976 with F.L. Smidth Co. of Denmark for the provision of technical guidance and of equipment and machinery. Included in this contract are the installation of additional facilities with a capacity of 750 ton/day (235,000 ton/year) and the replacement of three units of 3MW diesel

generators; construction works of two cement silos whose storage capacities are 4,000 tons and 2,500 tons, respectively; and the replacement of the ropeway, which was provided by grants from the U.K., as well as the extension of ropeway to the limestone quarry. Delays have already occurred in construction works, due to the difficulties in obtaining necessary foreign exchange by the local civil engineering contractors, and the completion is now expected to be delayed by more than a year from the originally scheduled February 1979.

Another firm, Nile Cement Corporation is facing still more difficult problems. This Corporation is operating substantially below capacity, and it was only in 1973 when its annual production exceeded 50% of the installed capacity of 100,000 tons. For the past seven years, an average rate of the Nile Cement's capacity utilization has been a little higher than 40%. Nile Cement's problems are as follows:

(i) unfavorable location of the plant, being 60 km separated from the quarry, and aggravated by an extremely poor road condition for the transport of limestone during the five or six months of rainy season (the location was selected inappropriately as a result of inadequate geological surveys and identification of deposits); (ii) the capacity of crushing equipment being substantially lower than that required by specifications; (iii) shortage of various component parts and diesel oil; (iv) insufficient training of technical staff; and (v) the Corporation's deteriorating financial position.

To remedy these deficiencies, a rehabilitation program was formulated and proposed by consultants from UNIDO, Egypt and others in 1975. Consequently the Construction Materials Corporation reached an agreement with Esche Werke Co. of West Germany for the replacement of crusher and with another West Germany firm, Krockner Co. for the renewal of cement production facilities. The rehabilitation work is currently on-going. With regard to the most difficult problem of the transportation

of raw materials, two proposals were recommended -- either Nile Cement Corporation purchase twenty-five trucks with a carrying capacity of 30 to 40 tons each or the Sudan Railway Corporation provide a sidetrack to the quarry. However, the Sudan Railway Corporation reportedly has not agreed on the latter recommendation in view of the small quantity of transportation and the financial position of Nile Cement Corporation has made it difficult to purchase the required trucks.

A third cement project in Sudan is the one proposed at Derudeb. For this purpose, Arab Cement Corporation was established in 1976. However, a mission from the International Finance Corporation (IFC), which visited Sudan in September 1978, re-assessed the proposed project and pointed out that Derudeb, which is more than 800 km away from Khartoum, the largest market of cement production in Sudan, is very unfavorably located, in view of the very gloomy prospects for the export of domestically produced cement.

In corroboration with IFC, the Sudan Development Corporation (SDC) has undertaken a comparative study to determine if the re-expansion of the Atbara factory would be more desirable than the original idea of the proposed Derudeb project. A conclusion is expected to be presented shortly, after consultation with IFC. Following terms and conditions are presently being considered by SDC for the proposed Derudeb cement project:

- (i) Financing plan
 - a) Equity participation from government: US\$20 million
 - b) Equity participation from foreign private sources: US\$20 million
 - c) Soft loan from foreign governments: US\$70 million
 - d) Custom Debenture: US\$20 million

Total: US\$130 million

- (ii) In order to save foreign exchange, the procurement of equipment and machinery would be made not on a full turn-key basis, but on a piece by piece purchase; and
- (iii) In order to improve the technical level of the managerial and engineering staff, a separate longterm contract is to be concluded with foreign consultants for the provision of a technical guidance.

A fourth cement plan in Sudan is to produce 400 thousand tons of cement a year (export of the whole products to Saudi Arabia is envisaged but the Sudanese Government has an option to procure up to 100 tons a year) at Marsa Alakiyai situated 75 km north of Port Sudan on the Red Seas coast. To carry out the fourth plan, Cement Production (Sudan), Ltd. was established in 1975 as a joint venture between US and Sudan. According to information supplied by Arab Cement Corporation, however, the activity of this firm is currently being suspended for technical problems.

A fifth plan is proceeding at Kapoeta (250 km to the east of Juba) of the Eastern Equatoria Province in the Southern Region. A feasibility study is currently being carried out by Krockner Co. of West Germany. There is also a sixth plan near Ed Damazine, the capital of the Blue Nile Province, to produce 100,000 tons of cement a year. However, this plan is still at a very early stage of preparation; only a preliminary geological surveys has been made so far.

3. Demand Projection for Cement

The demand for cement in Sudan has shown a very unstable movement. Between 1954 and 1964, the country's cement consumption had recorded a 5.4-fold increase, or an annual growth rate of 13.3%, reaching to 414,000 tons in 1964. However, the domestic consumption of cement declined sharply in 1965 to 132,000 tons, or to less than one-third of that in the previous year. Since then, however, the consumption kept increasing steadily until it reached 313,000 tons in 1977. The cement domestically produced at Atbara and Rabak represent 57% of the total consumption. The annual growth rate of cement consumption is 7.4% from 1965 on.

Such a discontinuous growth of the cement consumption makes it extremely difficult to project future demand, but it would be reasonable to estimate the annual growth rate of the demand for cement at 8.0% on the basis of the following data: consumption during the period from 1965 to 1977; the projected GDP growth rate in the Government's Six-Year Plan; and growth rates of cement consumption in African Countries. Projection of the demand for cement should not be based on the domestic demand alone but should include the possibility of export. The conceivable client countries are Saudi Arabia, Egypt and such neighboring countries as Ethiopia, Somalia, Yemen, etc. Except for Saudi Arabia, these countries as export markets involve uncertain factors greatly. The demand for cement in Saudi Arabia is presently estimated at 700 to 750 tons a year. However, at the completion of the country's five-Year Plan (1975 to 1980) and of its large-scale projects, a sharp increase in the cement demand is unlikely to continue. Moreover, exports to the country will inevitably have to compete with the low-priced exports from East Europe (US\$56 to 57 per ton). In addition, Saudi Arabia is currently expanding its cement production capacity and is expected to become a cement exporting country ultimately in the foreseeable future.

In view of the above, it is difficult for Sudan to expect a favorable environment for its cement export. The future demand would therefore be almost entirely domestic.

4. Past Feasibility Studies on the Derudeb Project

Subsequent to a preliminary geological survey by a Soviet team in 1972, a feasibility study was made by consultants from Argentine in 1974. Subsequently, another feasibility study was carried out by Sudanese consultants in 1978. According to these reports, it is stated that abundant clay and limestone in good quality are available in Derudeb, but unfortunately, detailed information of explorations has not been released, and therefore there is no way of ascertaining proved deposits from these documents.

5. Proposed Size of Production Capacity

In the afore-mentioned two feasibility studies, a 500,000 tons/year capacity is proposed. The merits and demerits of this proposed size may be summarized as follows: (1) On the merit side, due to economies of scale, the production cost per unit could be reduced as the increase in size of capacity, specifically in such a case where the development of the related infrastructure would cost almost the same as that of the main plant itself; and (2) The larger production capacity could meet more flexibly a rapid increase in cement demand if large scale project should start; and on the demerit side, (3) At the time of completion of the proposed plant, production capacity is expected to be well over the internal demand and as a result the rate of capacity utilization will have to be kept low. Also, a long time will be needed for the plant to reach a full operation. However, in view of the scale merit, the production capacity of 500,000 tons a year (1,500 tons a

day) is recommended and a tentative calculation of the internal rate of return also justifies the larger production capacity.

6. Related Infrastructures

In proceeding with this proposed project, it is necessary to construct the following related infrastructures:

- a) A new paved road (7 m in width and 18 km in total length) connecting the proposed plant site to the Derudeb station.
- b) A new railway (single track 18 km in length and also needed is a marshaling yard within the plant precincts) connecting the plant to the Derudeb station.
- c) Communications facilities including radiotelephone system (to enable communications at least with Khartoum, the capital).
- d) Housing for employees (about 320 housings for 80% of the employees whose total number is estimated at 400).
- e) Purchase or acquisition of the right to use of the existing water supply system and installation of water supply piping (about 18 km long).

7. Construction Schedule

Since the prospect of securing finance for this project is not definite the construction schedule has not yet been determined. According to Arab Cement Corporation, 3 months would be required from the construction to the start of

operation. In light of other experiences, however, at least 36 months (3 years) is likely to be required.

In view of an anticipated demand and the scale of production, the completion date of this project could be set at the beginning of 1984, instead of the consultants' target date at the beginning of 1980.

8. Construction Cost

The total construction cost of this project, as submitted by Arab Cement Corporation, is US\$112.2 million, of which US\$92.2 million are appropriated for the main production unit and the remaining US\$20 million for the development of the infrastructures. This estimation is exactly the same as that submitted by a European manufacturer in 1977 for the detailed designing on a turn-key basis. However, taking into account of the following factors as: (1) subsequent changes in the official foreign exchange rate; (2) delay in the start of this project; and (3) the likely reduction in cost as the result of international competitive tender, the construction cost of the main production unit would have risen to about US\$100 million. In addition to the cost of constructing the necessary infrastructures, (1) pre-operation expenses, (2) consultant fee, (3) technical guidance fee, and (4) operational cost should be included, and total cost would amount to US\$124.2 million, which may be itemized as follows:

(Unit: million US dollars)
Of which foreign
exchange component

Cost of plant construction (Daily production of 1,500 tons on a clinker base)	100	(80)
Infrastructures (road, railway, communications equipment, housing, water supply system)	16.4	(4)
Others	7.8	(4)
Pre-operation expenses	2.2	
Consultant fee	2.0	
Technical guidance fee	2.4	
Operational cost	1.2	
<hr/> Total	<hr/> 124.2	<hr/> (88)

9. Economic Evaluation

In their economic evaluations, the Sudanese consultants have made a cash-flow analysis for the period between 1981 and 1991 and have obtained an internal rate of return at about 24%. However, their calculations are based on too optimistic assumptions as to the domestic price of cement in 1981 amounting to \$80/ton (ex factory) and the export price of \$60/ton (ex truck at port of export) which, moreover, are assumed to rise at the rate of 7.5% a year. In addition, there are many questions with regard to the consumption tax, construction cost and prospects of export. Our re-assessment suggests that the domestic sales price (including the consumption and development taxes) would be more realistically set at \$58.6 ton

(ex-factory) which is almost the same as the current domestic sales price, and the export price at \$30/ton (which can be converted into \$60/ton CIF west coast of Saudi Arabia). As a sensitivity analysis, the calculations of the internal rates of return were made for the cases of the sales price plus 5%, plus 10%, plus 15%, plus 20%, and plus 34.8% (equivalent to the price of imported cement at the Khartoum market), respectively, as shown in the table below. As for the output, various operational sizes listed below are assumed taking into account the relationship between production capacity and consumption.

Internal Rate of Return (IRR)

Unit: %

Size of operation	(i)	(ii)	(iii)	(iv)	(v)	<u>Atbara</u>
Price of cement						
Sales price	1.4	1.7	2.6	3.2	3.7	5.8
Sales price plus 5%		2.6		4.1	4.8	6.8
Sales price plus 10%		3.4		4.9	5.7	7.8
Sales price plus 15%		4.1		5.7	6.5	8.8
Sales price plus 20%	3.8	4.9	5.7	6.5	7.4	9.8
Sales price plus 34.8%	5.5	6.8	7.8	8.8	9.7	

Remarks:

(i) Production is made only to meet domestic shortage.

Rate of capacity utilizations as follows:

1st year: 14%; 2nd year: 22%; 3rd year: 32%;

4th year: 42%; 5th year: 52%; 6th year: 64%;

7th year: 76%; from 8th year on: 90%.

(ii) Production is made not only to meet domestic

shortage but also for export. Rate of capacity

utilization: 1st year: 50%; from 2nd year on:

90%.

- (iii) Operation size: domestic consumption nationwide productive capacity. Rate of production utilization; 1st year: 52%; 2nd year: 56%; 3rd year: 61%; 4th year: 65%; 5th year: 70%; 6th year: 76%; 7th year: 82%; from 8th year on: 90%.
- (iv) The rate of capacity utilization would rise gradually year by year regardless of with demand forecast; 1st year: 50%; 2nd year: 70%; 4th year: 80%; and from 5th year on: 90%.
- (v) Maximum production utilization regardless of demand forecast; 1st year: 50%; from 2nd year on: 90%.

The above table shows that the value of IRR is greatly affected by the rate of capacity utilization which varies with the trend of cement price and with the demand situation. Currently, the construction of large-scale dams has been suspended and the aid giving countries are bringing in necessary materials including cement in the building of roads. Under the circumstances, it is difficult to assume the cases, (iv) and (v), which anticipate a demand greater than a forecast and so is the case (ii) that presupposes great amounts of export. If the domestic cement price is raised to the level of the imported price in Khartoum in the cases, (i) and (iii), the likelihood of which is the greatest, the IRR ranges from 5.5 to 7.8%.

10. Executing Agency

The executing agency of this project is Arab Cement Corporation which was established in 1976. The staff of this corporation consists of one full-time officer and two part-time officers, who directly report to the board, assisted by a clerk, a typist and an office boy. Temporary technical consultants are employed from time to time. In view of the

apparent weakness of the executing agency it is desirable to strengthen the entity and to ensure proper operation, by placing procurement of equipment on a full turn-key basis, and by retaining proper consultants for technical guidance at least three years after the start of operation.

11. Problems Remain to be Solved

The following points need further scrutiny:

- a) Confirmation of the proven deposits and quality of the raw materials for cement
- b) More detailed examination of the construction and operational costs

In view of the apparent weakness and lack of experience in the organization and staff of Arab Cement Corporation, and in order to ensure the smooth execution of the project, procurement should be based on a full turn-key basis for the construction works.

While efforts are being made by Arab Cement Corporation to proceed with the original idea on the one hand, a comparative study is being carried out on the other hand by the Sudan Development Corporation in coordination with IFC to find out if further expansion of the Atbara plant is more feasible in view of the substantially unfavorable location of the proposed Derudeb project. In view of the above, it is considered utmost necessary for the Sudanese Government to reach an agreement among various agencies concerned as soon as possible.

Part IV: Proposed North Khartoum Steam Power Plant Project

1. The Role of Electric Power Industry in Sudan

If developed properly, the power industry in Sudan will contribute considerably toward the improvement of the capacity utilization of the country's manufacturing industry. The rate of capacity utilization of the manufacturing industry is generally low and often lower than 50%. The causes for such a low rate differ according to the type of products, plants, etc.; for example, the obsolete production facilities and shortages in parts and raw materials due to shortage of foreign exchange, etc. One of the general causes, however, is the unstable supply of electric power. In the views of the Sudan Manufacturing Association, this under-utilization is mainly caused by the unstable supply of electric power. If an adequate and stable supply of power is ensured, it will no more be necessary for the large industrial plants to install self-generating facilities. This will contribute toward the improvement in the rate of return on fixed capital and in productivity of both capital and labor. Moreover, import of fuel oil for a number of small-size diesel generators could be reduced so as to improve the country's balance of international payments. Also, it is needless to say that rural electrification will help stabilize the people's livelihood in rural areas. In the agricultural sector a program is being formulated to replace the existing diesel engines of irrigation water pumps with electricity. If a stable supply of electric power is ensured, the agricultural productivity accompanied with the pump irrigation, will be increased so as to contribute to the increase in foreign exchange earnings.

2. Development of Electric Power Industry in Sudan

The power supply facilities in Sudan are divided into the following three groups: (1) The Blue Nile Grid; (2) the Eastern Grid; and (3) 15 other points served by small-scale diesel generators. The largest of them is the Blue Nile Grid which covers the region including Khartoum, the capital of Sudan. The main facilities in the Blue Nile Grid are the hydroelectric power plants of the Senner Power Plant (15 MW) completed in 1962 and the Er Roseires Power Plant (90 MW) completed in 1971. They have transmission network of 110 KV and 220 KV single-line, respectively. Additionally, in the vicinity of the capital are the Buri Diesel Generation Plant (15 MW), completed in 1969, and the Kilo X Gasturbine Generation Plant (15 MW), which operate at peak hours. The Roseires Plant is a part of a multi-purpose project intimately linked with an irrigation project which was started in 1962 under a loan from the World Bank. The power project, under which the hydroelectric station was installed at the Roseires Dam in 1966, is called the Power I Plan, which included the installation of electric generator units (Roseires Power Plan), one 15 MW gas-turbine generator unit, a single overhead 220 KV transmission line with double steel towers which stretches 485 km between the Roseires station to Khartoum. The subsequent Power II Plan financed by the World Bank, is intended to supply the power primarily to meet the demand in the agricultural and industrial sectors for the period up to 1980. This plan includes an additional installation of No. 4 generator (42 MW) at the Roseires station and of 15 MW of diesel unit at Buri. Completion of various facilities is behind schedule, but it is expected in summer this year. In addition to the above, included under the Power II Plan are a 5 MW diesel power station at Juba with complementary transmission line extensions and long-term planning studies to choose alternatives for long-term power development in the Blue Nile Grid and adjacent grids during the period 1980-90. The long-term

planning studies, which led to the proposed Power III Plan, were carried out by two British consultant firms. The expansion program of the Blue Nile Grid forms the main part of the Power III Plan. Financing for the Buri Diesel Station, the addition of a 40 MW hydro unit at Roseires station and the installation of transmission line are expected to be made by co-financing between the World Bank and EC countries. Consultants are being selected under a technical assistance credit from the World Bank, to carry out feasibility studies on the proposed North Khartoum Steam Power Station, the Buri Diesel Station, and the Port Sudan Grid.

3. Outline of Power III Plan

The master plan of the Power III Plan was formulated by two British consultant firms (Sir Alexander Gibb & Partners, and Merz and McLellan) during the period from February to May of 1978. The demand for power is anticipated to increase from 126 MW to 324 MW in 1986, the average growth rate being estimated at 12.5%. Although this growth rate is a little higher than the average growth rate of 10% for the past ten years, it is based on the actual application from the agricultural and industrial sectors. In order to meet an increasing demand, the Power III Plan includes the following measures.

- the addition of a 60 MW diesel generator at the Buri Power Station
- Addition of No. 5 and No. 6 units at the Roseires Hydroelectric Station
- Construction of the North Khartoum Steam Power Station (120 MW)
- Expansion of the transmission line between the Buri Station and the North Khartoum Substation and that between the Sennar Station and the Kilo X Substation.

In order to meet the short-term demand for power, which is anticipated to increase rapidly by 1982, this Power III Plan specifies the following schedules which should be accomplished within a short period:

The Buri Diesel Power Station (10 MW unit x 6)

No. 1 unit: construction to be started in 1980

No. 6 unit: construction to be completed in
March 1982

The Roseires Hydroelectric Station Plant

No. 5 unit: construction to be completed in
June 1982

No. 6 unit: construction to be completed in
June 1982

In parallel with the construction of the above power plants, doubling of transmission lines from the power stations to Capital Khartoum is scheduled to be completed in 1980. On the other hand, in order to meet the long-term demand for power which is anticipated during the period from 1983 to 1986 the construction of a Steam power station is recommended, namely;

The North Khartoum Steam Power Station (30 MW unit x 4)

No. 1 unit: construction to be started in 1983

No. 4 unit: construction to be completed in
March 1986

As stated before, financing of the major components of Power III Plan has already been secured by the World Bank and EC countries. This report will focus on the construction of North Khartoum Steam Power Station, for which source of finance has not yet been determined. During the Mission's visit, strong request was made by the Public Electricity and Water Cooperation (PEWC) and by a post appraisal mission from the World Bank which visited Sudan at that time that the Japanese

Government consider financing of the proposed North Khartoum Power Plant which calls for the highest technological proficiency. The Power III Plan is scheduled to be presented to the board of directors meeting of the World Bank in August this year, and the Japanese Government is requested to indicate its intentions by May or June at latest.

A consortium meeting sponsored by the World Bank was originally intended to be held at the beginning of this year to discuss the joint-financing for the Power III Plan. Of the major components, however, hydroelectric and diesel power units and the transmission lines are likely to be financed by France, the U.K. and other EC countries together with the World Bank, the remaining major item being the North Khartoum Steam Power Plant along. As a result a consortium meeting is unlikely to be held.

4. Demand Projection for Electric Power

The demand forecast for electric power upto 1985/86 in the Power III Plan is based on PEWC's Annual Development Plan 1977/1978 as well as on the result of market research.

Apart from the consultants' projection of future commercial energy requirements, a macroscopic forecast was attempted by the Mission using the correlation with the GDP growth and an approximately similar result was reached, thus the consultant's projection could be regarded as justifiable.

5. Importance of Steam Power Plan in Sudan

In the on-going explorations for oil in the southwest Sudan Chevron Co. was reportedly successful in reaching a comparatively good-quality oil stratum, but a commercially

viable oil deposit has not yet been identified.

Having no definite energy resources such as coal, petroleum and geothermal heat, the Sudan will have to rely on the water of the Nile as the sole energy source of electric power. However, one should note that there are several severe restraints imposed on the power development which utilizes the Nile. First, as the main stream and tributaries of the Nile are wide and provide a low head, both large-size dams and large-size turbines have to be installed for hydraulic power generation, thus making the construction costs comparatively higher. Second, because of the sand and stones accumulated by the seasonal flood between July and September, reservoir levels cannot be increased significantly despite the increasing river flows, and consequently the generating capacities sharply drop to only 30%. Third, the dams in Sudan are built primarily for irrigation, and there is the periodic conflicts between the needs of irrigation and power. Demand for electric power is greatest during the two months of April and May. But this peak months also just coincide with the low reservoir levels following the irrigation season between October and March, with the result the available generation capacity of the hydroelectric power station dropping to from 50 to 67% of the installed capacity. Fourth, there is the international water agreement with Egypt on the utilization of Nile water. This has made it extremely difficult for Sudan to initiate further large-scale irrigation dams. In accordance with recommendations of the Nile Water Study, which was undertaken by the consultants in connection with Power III Plan, the proposed 10-meter raising of the height of the Roseires dam, originally included in the Power III Plan, was currently being suspended. These restraints on the utilization of the Nile water therefore require thermal back-up. Specifically during the periods of flood or low reservoir levels, thermal electric energy has to be generated at base load.

Under Power III Plan, the additions to the existing generating capacity, installation of new power stations, and transmission network of the Blue Nile Grid were selected as the least cost solution from various alternatives, with a varied mix of hydroelectric, diesel, steam power, and gas turbine generation and varying requirements for additional transmission. In view of the critical restrictions of utilizing the Nile water, the proposed North Khartoum Steam Power Plant is an indispensable part of the Power III Plan. The proposed Steam Power project should therefore deserve specific consideration.

6. Descriptions

The equipment necessary for the North Khartoum Steam Power Generation Plant is as follows:

- (1) Boiler equipment
Natural circulation; pressurizing type furnace;
bottom support; steam atomizing fuel oil burner;
outdoor boiler
- (2) Turbine equipment
Single barrel; single shaft; 3,000 rpm; condenser
turbine; steam condition; 60 kg/cm² 485°C at inlet
of main steam stop
- (3) Condenser equipment
Surface type condenser; cooling water; Blue Nile
riverwater; accessories; backwasher; ball cleaning
device
- (4) Generator equipment
Rotating horizontal shaft field magnet type;
direct-coupled exciter; 3,000 rpm; 50 Hz 30 MW
air-cooled type

(5) Fuel oil equipment

9,000 kl unit x 2; floating roof type; bank made of steel plates; equipment which can take in oil from both tank lorries and freight cars

By and large, the proposed site is believed to meet the locational requirements of a power plant. The site, however, is in the vicinity of an airport, and hence the limits of the height of structures have to be fully investigated at the time of detailed designing. The modes of transporting heavy machinery must also be examined.

In order to ensure reliability of a power system, the optimum capacity of a single unit generator has to be kept at about 10% of the entire system capacity. In view of the above, the proposed unit capacity of 30 MW is technically justifiable.

The cooling system for the steam power plant condenser is as an important factor of this project. The cooling water may be obtained from either the Nile river or the public water supply. While the former appears to be more viable, further study is needed to ascertain whether the pump structure or the water-intake tower system would ensure more stable water-intake, in view of the large difference reaching about 6 m in the water level between the dry and wet seasons.

Moreover, the fuel oil has to be transported from Port Sudan over a long distance. This poses a serious problem and as an alternative the construction of a power plant of the same size at Port Sudan along with the installation of a 800 km power transmission line between Port Sudan and North Khartoum might deserve consideration. However, a tentative comparison of cost estimates suggests that the original idea would be much better in view of the costs and length of time involved in the construction of transmission line.

7. Construction Schedule

The proposed construction schedule under Power III Plan is as follows: 26 months for the Buri Diesel Power Plant; 34 months for the expansion of the Roseires Power Plan; and 43 months for the Steam Power Plant. In view of the present condition of Sudan, this construction schedule appears to be reasonable. As the progress of the various projects under the on-going Power II Plan is 10 to 20 months behind schedule, it is necessary to start the Power III Plan as soon as possible in order to meet increasing demand.

8. Construction Cost

The construction cost as estimated by the consultants is listed in the table below. It is to be noted that the old exchange rate of US\$2.5 = S£1 is applied here.

Construction Cost of North Khartoum Thermal Power Plant (30 MW x 2)

	<u>Foreign currency</u>	<u>Sudanese currency</u>	<u>Total</u>
US\$ (1,000)	58,868	13,727	72,595
S£ (1,000)	23,547	5,491	29,038

Under the assumption that the two units of 30 MW generators are delivered on a full turn-key basis and that the major items of equipment are imported from Japan, the construction cost is re-estimated separately as shown in the next table. As can be seen, this is approximately equal to the consultants estimates, thus endorsing the reasonableness of the consultants' estimates.

Construction Cost of North Khartoum Steam Power Plant
(30 MW x 2)

Item	S£1,000			US\$1,000		
	Foreign exchange	Sudanese currency	Total	Foreign exchange	Sudanese currency	Total
Boiler, turbine, generator, and auxiliary generator	15,000	1,650	16,650	30,000	3,300	33,300
Fuel oil tank, water treating plant and other devices	1,620	180	1,800	3,240	360	3,600
Substation	540	135	675	1,080	270	1,350
Architectural work	4,650	1,165	5,815	9,300	2,330	11,630
Civil engineer- ing work	1,890	2,835	4,725	3,780	5,670	9,450
Supervising fee engineering fee and reserves	4,895	1,225	6,120	9,790	2,450	12,240
Grand total	28,595	7,190	35,785	57,190	14,380	71,570

Remarks: Rate of foreign exchange: US\$2.0 = S£1

9. Economic Evaluation

IRR was not calculated for the entire PEWC but for the North Khartoum Steam Power Plant alone. The average revenue per unit sold which has been deduced from the electric tariff

structure of the PEWC is 24.6 mms/KWh, close to 22 to 24 mms which was obtained from the forecast cash flow under the Power II Plan. The Power III Plan, however, assumes that the construction cost of the Roseires generator would be 2.6 times as high as that of the generator of the same capacity installed under Power II Plan, presumably reflecting the expected rise of prices after 1983. In view of the above, it appears reasonable to assume 37 mms, or 50% higher than the current unit revenues, as the probable average revenues per unit sold, for the calculation of IRR. Also, the case of 30 mms is tested as a sensitivity analysis. In addition, the case of the reduction of the construction cost by 10% as a result of international bidding is calculated, as shown in the table below.

<u>Investment</u>	<u>Construction cost same as proposed</u>		<u>Construction cost reduced by 10%</u>	
	30mms	37mms	30mms	37mms
Average revenues per unit sold in mms per KWh				
IRR (%)	10.1	13.1	11.6	14.9

In view of the rising trend in the construction cost it is advisable that the current tariff structure be revised at least to earn 37 mms per KWh sold by PEWC. Under the assumptions as stated above, the IRR would be 13.1%.

10. Executing Agency

The executing agency for this project is PEWC. In spite of the loss of PEWC's water operations, PEWC's overall financial positions are satisfactory. For instance, PEWC's net

income before tax in FY 1976 amounted to S\$11 million.

The qualified engineers including the managers of PEWC are 228 in number. However, PEWC has no expertise in executing any single projects by itself but depends on foreign and local consultants for the control of a fairly wide range of engineering work, coordination, etc. In view of the above, it is desirable that PEWC retain suitable consultants in order to ensure effective execution of this proposed project.

