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Report No. Z-17/4

RESTRICTED

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

OPERATIONS EVALUATION REPORT: ELECTRIC POWER

CASE STUDY: VRA, GHANA

March 24, 1972

Programming and Budgeting Department
Operations Evaluation Division

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CURRENCY EQUIVALENTS:

	<u>Before 1967</u>	<u>1967-1971</u>	<u>1972</u>
1 New Cedi (N¢) = US\$	1.40	0.98	0.78
1 US\$ = N¢	0.71	1.02	1.28

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I. INTRODUCTION

1.01 The Volta River Authority (VRA) was established by the Volta River Development Act of 1961 to construct and operate the Volta River Project, which was built between 1962 and 1965 and partially financed by Bank Loan 310-GH. The delegations of policy laid down in the Act, which was reviewed by the Bank prior to passage, enable the Authority to take any action required for the success of the Volta River project and require it to conduct its affairs in accordance with sound public utility practices. Under this Act, the Authority is empowered to go well beyond the boundaries of the power sector, making it an integrated regional development agency. The creation of the Volta Lake opened up the possibility of the development of water transportation and fisheries. VRA is also responsible for general medical research and promotion of the well-being of the population in the area. It is administered by a seven-man Board of Directors appointed for terms of three years; the members include the Chief Executive of VRA, the Managing Directors of the Electricity Corporation of Ghana (ECG) and of the Volta Aluminum Company (VALCO), and four members representing the general public.

1.02 The Volta River hydroelectric station, located at Akosombo, has four 147 MW units installed since 1966. VRA owns and operates an 800 km 165 kv transmission ring serving the VALCO smelter (built in connection with the project), ECG systems in the main towns, a number of smaller towns and villages, and gold and diamond mines. Since 1966 discussions had taken place between VRA and Togo and Dahomey for purchases of VRA power by them. The power agreement between the three countries was signed in August 1969 and the transmission line from Akosombo to Lome (Togo) and Cotonou (Dahomey) is expected to be in service in 1972.

1.03 Almost all consumption of publicly supplied electricity occurs in the southern part of the country where about two-thirds of the total population lives, and where the bulk of commercial agriculture, manufacturing and all mining is located. Public generation, transmission and distribution of power are the responsibility of two organizations, VRA and ECG. The principal private producers of power, the mines, have placed their generating equipment on standby and use power produced by VRA. ECG is responsible for distribution of VRA power in southern Ghana and for the generation and distribution of diesel power in areas that cannot as yet be economically connected to the VRA transmission system.

II. THE ASSOCIATION BETWEEN THE BANK AND THE AUTHORITY

2.01 The Volta River Authority received two loans from the Bank as follows:

Loan No.	Date of Loan Agreement	Effective Date	Closing Date	Amounts (\$ mln)		Interest	Period (years)	
				Committed	Disbursed ^{a/}		Grace	Term
310-GH	2/62	2/62	4/71 ^{b/}	47.0	47.0	5-3/4%	6	25
618-GH	6/69	10/69	12/73	<u>6.0</u>	<u>2.9</u>	6-1/2%	10	25
				<u>53.0</u>	<u>49.9</u>			

^{a/} As of December 31, 1971.

^{b/} Original closing date was June 1967 and was extended twice.

2.02 After several years of complex preparation and negotiations, Loan 310-GH was made to assist in financing the Volta River Authority Hydroelectric Project (with four units installed totalling 588 MW) and transmission facilities to permit bulk sales to VALCO's smelter, several large mining enterprises, and the Electricity Corporation of Ghana (ECG). The United Kingdom Export Credit Guarantee Department (ECGD), and the United States Export-Import Bank (ExIm) and Agency for International Development (AID) also provided loans aggregating US\$51 million equivalent (see Section III below for a more complete history of the loan). The power project was supposed to be completed by mid-1966 in order to supply power to the aluminum smelter of VALCO which had negotiated with VRA a 30-year contract for firm power and was committed to build the aluminum smelter.

2.03 The Loan and Guarantee Agreement provided, in addition to the usual clauses regarding long-term debt incurrence and engagement of independent auditors, that:

- a) withdrawals from the loan funds (including U.S. and U.K. loans) would not at any time exceed 50% of the amount expended on the project;

- b) VRA would not change the rate for power sales in the contract between the Authority and VALCO without the Bank's agreement;
- c) the Government would undertake to reorganize the existing Electricity Division of the Ministry of Works and Housing (the predecessor of ECG) as a statutory corporation not later than the date when the Volta River Authority was ready to sell power.

The terms of the loan contained also a performance target, to be met only by 1974, of an 8% return, from power operations, calculated after payment of interest, on the Government's equity.

2.04 The project was essentially completed by mid-1965 and totally by mid-1966; initial sales of power to ECG and mines started late in 1965 and to the smelter in March 1967. Three pot-lines had been installed in the smelter by 1967 and VALCO started negotiations to finance a fourth pot-line. VRA's contractual obligations to serve increasing demand from the smelter have required it to install additional generating capacity by April 1972 at the latest. In 1969 VRA requested the Bank to help finance the final two units, which would bring the power plant to its ultimate capacity of 882 MW, and associated substation facilities. Conditions of effectiveness for the loan prepared by the Bank were that the Canadian Government's loan to VRA be also effective and that VALCO make satisfactory arrangements to finance the expansion of its smelter. Loan 618-GH of US\$6 million equivalent became effective in October 1969. All major contracts have been awarded; civil works started some weeks behind schedule. It is anticipated that the additional units will be in operation on schedule.

III. THE GENESIS OF THE PROJECT

3.01 Development of the Volta River basin in Ghana has been the subject of many studies from time to time since the end of the 19th century. The discovery of bauxite in 1915 first directed attention to the possibility of generating hydroelectricity from the Volta to produce aluminum from local ore. Following a study in 1951 by engineering consultants recommending the development of an integrated aluminum scheme supplying the sterling area, the Gold Coast Government set up in 1953 a Preparatory Commission to follow up the work already done and to examine the problems to be overcome. The Commission reported in 1956, outlining a broad plan for a power plant at Ajena, bauxite mining and associated railways, an aluminum smelter of 120,000 tons initial annual capacity, and a port at Tema; total cost of the plan was estimated at US\$600 million in a first stage. Power was estimated to be produced at the equivalent of 3 mills/kwh (US\$0.003) which was the maximum price the prospective aluminum companies had agreed to pay. Construction of the port began soon after, but otherwise there was little progress in the years immediately following this report, partly because of the large amount of finance required, partly because the country was about to become independent as Ghana, and partly because of the discouraging world outlook for aluminum at that time. First approaches and visits to the Bank had been made during 1953-1956 by the Preparatory Commission which saw a possible role for the Bank as provider of finance for power generation and protector of the private aluminum companies involved (Aluminum Ltd. of Canada and British Aluminum Co.). A first Bank mission sent in early 1957 to review economic conditions in Ghana questioned the advisability of undertaking the project at that time.

3.02 The Government of Ghana maintained their interest in the Volta scheme, which was made a keystone of national policy, and in 1957 approached the U.S. for possible assistance in bringing the project back to life. U.S. officials studied the project and asked for a review to be made. The engineering aspects of the power project were reappraised in 1959 by a firm of consultants, Kaiser Engineers and Constructors, Inc. (KECI), in a study financed jointly by the Governments of Ghana and the U.S. The consultants' proposals were for a dam and a power station to be constructed at Akosombo, a more economical site than Ajena; they confirmed the necessity of developing a large industrial load to justify the large hydroelectric project and recommended the construction of a 120,000-ton aluminum smelter adjacent to Tema, the new port area, approximately 70 km from the dam site and 20 km from Accra. The project was made more attractive for financing by eliminating the capital cost of developing both the railway system and the bauxite mines plus the cost of building an aluminum plant, all through the import of

alumina powder; total cost of the scheme was estimated at US\$350 million. Moreover, a substantial change was introduced in the project by including a national transmission network for carrying the surplus power of the Volta, with the result of spreading the burden of the investment in the dam and the power plant almost equally between the aluminum and non-aluminum consumers of power; power for aluminum was estimated to be produced at a cost of 2.5 mills per kwh.

3.03 The Government made an engineering contract in 1959 with KECI to draw up the project plans. During the same year, a consortium grouping Kaiser Aluminum and Chemical Corporation - KACC (leader), Alcan, Alcoa, Olin Mathieson and Reynolds formed the Volta Aluminum Company Ltd. (VALCO) to explore the possibility of establishing the smelter. The Ghana Government discussed KECI and VALCO proposals with the Governments of the U.S. and the U.K., who both showed interest, and later asked the Bank to appraise the electric power aspects of the scheme.

3.04 In 1960, the Bank studied and reported upon Ghana's economy (Report EA-110a) and upon the power project (Report TO-249a). Preliminary comments on the merits of the Volta Project were not enthusiastic. The Bank estimated that Ghana's non-smelter power needs would be less than predicted by Kaiser and recommended building the transmission network to carry power to general consumers only later; the Bank's analyses, based on higher cost estimates and power prices of at least 3 and preferably 3.5 mills per kwh to the smelter, indicated that the returns on investment would be very inadequate during the earlier years of operation and too low in the long run "to be particularly attractive." In sending these reports to the Government the Bank also stressed that, if the project were to be undertaken, the public investment program should be kept within bounds and should concentrate on productive investments.

3.05 During the subsequent negotiations between Ghana and VALCO for a Master Agreement and a Power Contract, Ghana used the Bank report as a "bargaining tool" and suggested a power price of about 3.25 mills/ kwh. The Bank, asked by Ghana to give its opinion on VALCO's offer of 2.5 mills/ kwh with a 10-year tax holiday; did not endorse VALCO's offer and strongly recommended Ghana to seek every possible means of compensating itself, in particular through taxation on VALCO, for the financial and income losses which would bear on the Volta Authority and the Government if Ghana decided to accept a low rate. At the same time, the Bank indicated that it would be prepared to make a loan of US\$40 million for the project (excluding the transmission network), in view of the extreme importance attributed to the

project by the Government.^{1/} After Kaiser considered withdrawal, Ghana and VALCO eventually agreed on 2.625 mills/kwh; the Bank insisted that this power rate be fixed for 30 years only instead of 50 years, with VALCO having the right to renew for 20 more years at a rate to be derived from an escalation formula suggested and worked out by the Bank. In the Master Agreement concerning the conditions under which VALCO would operate in Ghana, it was agreed that (i) Ghana and the Volta River Authority would build a dam and power plant and supply power to VALCO, (ii) VALCO would build a smelter and pay for Volta power in U.S. dollars with an obligation "to take or pay for" a minimum amount of power each year, and (iii) VALCO would be given a 10-year tax holiday and complete freedom in its operations. It was also agreed that VALCO would not process Ghanaian bauxite at first in order to reduce the amount of finance needed, but after 10 years it would get a special tax incentive for doing so; VALCO's shareholder-customers would provide VALCO with imported alumina and pay VALCO a tolling charge for the aluminum ingots to be bought in sufficient quantity to enable VALCO to meet its power commitments. All VALCO's imports and exports (aluminum) would be exempt from customs duties.

3.06 VALCO was then constituted as an operating company with 90% of its shares owned by KACC and 10% by the Reynolds Metals Company; other companies had departed from the consortium. To encourage these two companies to undertake the smelter project, the U.S. Government, which had taken a deep interest in Ghana's projects, agreed to help finance the smelter with a US\$96 million loan from the ExIm Bank and to guarantee the US\$32 million investment of the shareholders against political risks.

3.07 The Government of Ghana decided also to proceed with the extended transmission system in view of better prospects of demand for power from the gold mines, and to undertake a preliminary study^{2/} of a hydro-electric project at Bui (upstream from Akosombo) associated with a transmission network designed to supply power to the general market. At this stage the U.S. Government agreed to finance half of the US\$14 million additional cost required for the transmission system, and the Bank agreed to increase its loan by US\$7 million to finance the other half. The Volta River Development Act establishing VRA was reviewed by the Bank before its enactment; the provision for a Chief Financial Officer with equal status to that of the Chief Executive of the Authority was removed so that the latter would have undivided authority over the staff.

^{1/} It seems likely that Ghana was about to accept 2.5 mills/kwh and wanted to test the Bank's willingness to make a loan under such conditions.

^{2/} An agreement was reached with the Government of the Soviet Union to undertake this study.

3.08 Before all the agreements, conditional on one another, concerning the power project and the smelter were eventually signed in February 1962, the civil works contract for the dam had been awarded to Impresit (Italy) through international competitive bidding. Ghana asked the Bank and the U.S. and Canadian Governments to provide candidates for the position of the Chief Executive of the Volta River Authority. A Canadian engineer from the Ontario Hydroelectric Commission was recommended by Canada and appointed to the post. The Volta River project was satisfactorily built on schedule below estimated costs and operations began in late 1965. Sales to the smelter started in early 1967 and aluminum exports from the smelter reached 113,000 tons in 1969.

3.09 Loan 310-GH which was the first loan made by the Bank to Ghana involved "risks which had to be and were taken," as it was put in the staff report on the project to the Bank's Board. The success of this project which was primarily built for the smelter was strongly dependent on uncertain non-smelter revenues which were expected to comprise at least 65% of total revenues. However, "even taking all the intangible benefits into account, the overall balance of costs and benefits to Ghana was on the positive side to only a modest extent"; the internal rate of return on Ghana's equity investment in the project (over an assumed 50-year life) was estimated at about 8.2%, and the investment was expected not to provide significant positive returns before the early 1970s nor to offset the cumulative losses from not investing an equivalent amount in liquid holdings before the late 1970s. One benefit frequently ascribed to this type of project, namely cheap power for non-smelter consumers, was not expected since it was assumed and recommended by the Bank that the Authority would have to charge these consumers "the highest possible tariffs consistent with obtaining maximum revenues."^{1/} The risks of nationalization and political turmoil feared by Kaiser-VALCO and the Bank have not materialized up to now and the Authority has succeeded in getting slightly better returns than expected, while charging non-smelter consumers tariffs lower than recommended.

3.10 Ghana has however been faced with unexpected difficulties which did not come under the Bank's scrutiny until a few years ago. Nearly 10 years after start of construction the full land and housing compensation and resettlement of the 80,000 people displaced from the lake basin, for which the Government assumed responsibility, has not been completed and has up to now been rather unsuccessful due mainly to the lack of proper organization and the lack of clear Government policy on land tenure. Initial efforts by the Government failed. In 1967 the Government entrusted VRA as its agent to undertake a land clearing and resettlement project with the assistance of UNDP and FAO World Food Program. A National Committee on Resettlement

^{1/} Quotations are extracted from the Appraisal Report.

Agriculture was not established until 1968. By the end of 1970 the cadastral survey for land acquisition was almost completed and about 75% of displaced households were established in new houses (see Table I). The Bank has recommended that VRA be discharged from its resettlement responsibilities so that VRA deal only with power activity "to make it easier to ultimately merge VRA's and ECG's operations." Lakeside health hazards have increased, though VRA has been assisted by WHO in its control measures and its research. River blindness and rates of bilharzia in children are high in some areas, breeding of Simulium demnosium flies has increased due to the high constant river flows and indications of trypanosomiasis have been found. The Bank has been assisting WHO in preparing a long-term project to control river blindness in an area encompassing Ghana. It also contemplates formulating and coordinating with WHO other future disease control and eradication projects and might consider financing them.

3.11 On the other hand, the foreign exchange earnings from VALCO's power payments (other earnings from the smelter are negligible) and the savings in foreign exchange resulting from not generating in thermal plants the energy required to meet the non-smelter demand have made a contribution to Ghana's balance of payments, exceeding total debt service on VRA for its foreign borrowing by some 50%, according to rough estimates for 1970.^{1/} The effect of the project on the balance of payments is expected to improve when VALCO increases its purchases of power for the smelter's fourth pot-line and when the complementary bauxite mining project envisaged initially, postponed in 1961 and presently under discussion between Ghana, Kaiser and IFC, is completed.

^{1/} In 1970, VRA's debt service amounted to US\$7 million, VALCO's payments to US\$5.3 million; savings on thermal generation for non-smelter demand are estimated at US\$5.5 million, i.e. US\$4.1 million for fuel required to generate 790 GWh and US\$1.4 million total debt service on the foreign exchange cost of a 120 MW thermal plant.

IV. DEMAND FORECASTING AND INVESTMENT PLANNING

4.01 The market served by the project was expected to be the smelter, the mines and general consumers in the southern area of Ghana. Projections were made up to 1976 in order to assess the long-term effects of the project on Ghana's economy and finances. Because of their different characteristics, the features and expected and actual developments of these three demands are discussed separately.

4.02 According to the Master Agreement negotiated between the Government and VALCO, VRA was required to make available to the smelter 166 MW of capacity (before transmission losses) in the first year, expected to be 1967, and up to 334 MW in 1972 and thereafter. The agreement also provided VALCO with another option for earlier increases of capacity, and projections were made for each option. Because VALCO exercised its first option, only the corresponding projections have been considered in Table II-A.

4.03 The consulting engineers estimated that the electricity demand of the general consumers in southern Ghana would grow by more than 13% p.a. over 1966-1970, reaching 121 MW and 555 Gwh in 1970. As regards the gold mines, it was assumed that the transfer of this load from captive generation to the Authority's system would be a gradual process; power being essential to the mines' safety, the mines would discontinue the operation of their own generating facilities as soon as they could satisfy themselves of the reliability of supplies from VRA.

4.04 Both in terms of power (MW) and energy (Gwh) the forecasts turned out conservative on the whole (Table II-A). Sales to the smelter, ECG and the mines were scheduled to start in 1967 and 1966 respectively; because construction was completed ahead of schedule, sales started in 1965 for ECG and the mines and in 1966 for VALCO. Sales to the mines were double the expected level because VRA power saved consumers the taxes on fuel for captive plants. VALCO's peak demand outgrew by more than 10% the power agreement's figures under the first option. ECG's peak demand was about 15% lower than expected, but energy sales to ECG were on the average similar to those forecast, the discrepancy originating from a higher ECG load factor due to higher industrial sales. The high demand has reflected the confidence of the mines in VRA supplies and the effective operation of the smelter which consumed after 1967 an amount of energy 25% higher than that established in the power contract

4.05 Over the 1966-1970 period, revenues from VALCO, like sales thereto, were 25% above the forecast, and revenues from mines were higher

by about two-thirds as compared to the forecast, but sales revenues from ECG were on average half the forecast level because the price charged to ECG by VRA was 7.5 mills/kwh against 15 mills/kwh assumed in the appraisal report; total sales revenues have been lower than expected by about 18%. As expected, total VRA revenues have depended in large measure on the size of the non-smelter load and on the tariffs charged to non-smelter consumers. On the other hand, costs for operations and for depreciation have been lower than expected by more than 20% on average mainly due to construction cost savings. As a result, net revenues fell below the forecasts by about 8% on average but the apparent rate of return on average net fixed assets in service grew from 0.6% in 1967 to 4.3% in 1970 as against 0.4% and 3.7% respectively expected in the forecasts. Correspondingly, the apparent net earnings for the country (defined as the net revenues less interest charges) represented a higher return on Ghana's investments, 2.8% in 1970 as against 2.3% forecast. However, the returns on the assets and the earnings on investments are to some extent over-estimated because only the foreign exchange portion of the assets was revalued after the 1967 devaluation of the Ghanaian cedi and because the assets include only one-fourth of the resettlement cost caused by the project (paragraph 5.03).

4.06 The amount of capacity installed was decided on the basis of the firm capacity concept (installed capacity less one unit as reserve); excluding the reserve unit, the remaining spare capacity was expected to decrease from 357 MW in 1966 to 79 MW in 1970, indicating an excess of two units in 1966 and one unit in 1967. According to the effective-peak spare capacity criterion (spare capacity at the critical time in the year when margin between demand and available capacity is least), it appears ex-post that the four units have been necessary since 1968 when the effective-peak spare capacity dropped down to 73 MW.

V. FINANCING OF THE PROJECT

5.01 The Government of Ghana had arranged financing totalling US\$196 million to provide:

- a) US\$190 million to meet the estimated cost of the 4-unit, 588 MW installation and to meet the resettlement cost;
- b) US\$6 million to meet part of the estimated cost of a fifth unit (which would have been required in early 1969 if VALCO had exercised its option at the earliest date possible).

The Government was prepared to invest up to US\$98 million as equity (including US\$29 million for resettlement and reservoir clearance) and obtained an additional US\$98 million by borrowing from U.S. and U.K. agencies and from the Bank (Table II-B). The Bank was expected to contribute 28% to total amounts of funds required for the power project (excluding resettlement and reservoir clearance), the U.S. and U.K. agencies 22% and 9% respectively. It had been assumed that the equity contributions and the various loan funds would be drawn upon as required, on a pro-rata basis.

5.02 Because of the reduction in the cost of the power project, both the Government contribution and the withdrawals from the foreign bilateral tied loans were lower than forecast. Procurements from U.S. manufacturers and the use of a local cost clause allowed withdrawals from U.S. loans to contribute the expected 22% to total sources of funds; but withdrawals from the U.K. tied loan contributed only 2%, the difference being offset by withdrawals from the Bank loan which took a greater share of the financing (34%). The Government contributed the expected share to the cost of the power project itself.

5.03 Resettlement capital expenditures had been estimated at N¢20.4 million to be met by the Government as equity. Resettlement up to 1967 was carried out by the Government and N¢21.1 million was spent on this aspect. Since 1967 an additional N¢4.7 million (of which about 60% for administration only) has been spent by VRA out of funds provided by the Government. Thus total resettlement expenses by the end of 1970 amounted to N¢25.8 million, and resettlement is still far from being completed. According to the Loan Agreement only N¢7 million of resettlement expenditures were charged to the scheme and included in VRA's gross fixed assets, the remaining expenses (about 75%) being taken over by the Government.

VI. PROJECT IMPLEMENTATION AND COST

6.01 Construction of the Volta River hydroelectric plant and the transmission lines has been generally very satisfactory. Though construction started several months later than expected, the plant and the transmission lines were commissioned on schedule, due to a shorter construction period of the plant (reduction of 7 months on average). The transmission network was completed during 1965 and 1966, instead of by November 1964 as expected, but transmission to VALCO's smelter was commissioned in due time before first operation of the smelter.

6.02 The monetary inflation which has taken place in Ghana has made it necessary to readjust the figures of the actual and estimated costs of the project (excluding interest during construction). The forecast construction costs set up in Table III have been computed excluding the allowances which were made in the domestic currency component for escalation in the costs of labor, and the actual costs have been obtained by deflating the local expenditures incurred each year for the project by the Ghanaian cost-of-living index. The result suggests that the total cost of the project (including only one-fourth of the resettlement costs; para. 5.03) has been about US\$18 million lower than estimated, savings originating mainly from the low bid received for the civil works contract and from the transmission part of the project. The foreign exchange component of the plant was higher than estimated by about US\$5 million, but its local cost component was reduced by about US\$11 million equivalent. Substantial savings were made on transmission, on both local and foreign components. As a result, the unit capital cost of the plant has been US\$209 per kw installed, and the unit cost for the whole scheme (plant and associated transmission) dropped from US\$285 expected to US\$253 actual.

VII. DEVELOPMENT OF THE INSTITUTIONS

7.01 The first Chief Executive of VRA was an engineer from the Ontario Hydroelectric Commission of Canada, assisted by an Indian Financial Adviser and by a Chief Engineer and a Chief Accountant both appointed from Ontario Hydro. The remaining staff of the Authority were Ghanaians. In addition, 15 Ontario Hydro staff were attached, under a technical assistance contract, to VRA to initially operate the facilities and give on-site training. Complete operational responsibility was transferred in 1967 to the Ghanaians who had received good training and have satisfactorily operated the facilities since. The present Chief Executive, a Ghanaian previously Chief Engineer of the former Electricity Division, was appointed to his present position in 1966. Senior staff positions (except Director of Engineering) were filled with Ghanaians after contracts with foreign staff were not renewed by VRA because of the costs of these contracts. The Canadian Engineering Director left VRA in May 1971 and has been replaced by a Ghanaian. Senior staff is well-qualified, but the Authority has been short of qualified middle-level staff. The accounting department needed reorganization in order to improve its procedures and reduce unqualified staff. VRA agreed during the second loan negotiations to carry out a review of its operations, organization structure, accounting system and staffing policies. VRA engaged for this purpose the services of Ontario Hydro who submitted a report in early 1971; the consultant's recommendations are still being examined by VRA.

7.02 Similar weaknesses have existed in the accounting department of the Electricity Corporation of Ghana. Establishment of ECG, to which the Government was committed under Loan 310-GH, was delayed because of political changes in Ghana and the time required to formulate the basic charter of the new corporation. The Government decree establishing the Corporation (ECG) was published in January 1967 and became effective in July 1967. The Chief Executive of VRA has been a member of its Board. ECG has received the assistance of engineering consultants (W. Lahmeyer of Germany) and of its auditors, Cooper Brothers (who are also VRA's auditors), for management consultancy and reorganization of its accounting system on a commercial basis. In 1968 ECG received an IDA credit of US\$10 million to cover the foreign exchange cost of a distribution expansion project; the distribution facilities were essential to meet power demands and to allow maximum use of VRA's energy to replace expensive diesel generation. A second IDA credit of US\$7.1 million was made in 1971. Because it was essential that distribution facilities in Ghana should keep pace with the development of generating facilities and because the bulk of ECG sales would come from its purchases of power from VRA, the credits to ECG were a logical sequence to the Volta project and have been expected to add materially to the profitability of VRA.

7.03 The Bank has continuously favored merger of the operations of VRA and ECG. Earlier proposals to merge the former Electricity Division with VRA did not materialize, mainly for political reasons, and ECG was established as a separate entity. Because of the heavy dependence of ECG on VRA power and of some possibilities of staff economies, consolidation of the two entities has continued to be considered. Recent efforts, however, have been hampered by the existence of the non-power activities undertaken by VRA under its status of regional development agency. In addition to re-settlement and lake research, VRA started in 1967 to operate a pilot transportation system on the Volta Lake with income losses in 1968 and 1969. The termination of this scheme in March 1970 by establishing, with Danish assistance, the Volta Lake Transport Company as a separate entity has been a first step toward making a merger of the two organizations possible.

VIII. CONCLUSION

8.01 The risks envisaged by the Bank when helping to establish VRA did not materialize significantly. All obligations undertaken by Ghana have been fulfilled and agreements respected. The VRA has been operating satisfactorily on the whole and VALCO and ECG have been well serviced. Except for some organizational and overstaffing problems caused by social and environmental responsibilities of VRA and by governmental pressures, and which are under study for future improvements, the management of VRA appears to have performed better than expected. Technical performance has been satisfactory, with small transmission losses and capacity out of service kept to a reasonable level. Financial indicators suggest an improving situation, though still fragile.

8.02 Mainly because of lower capital costs than expected, and partly because of higher sales than expected, VRA has apparently been able to earn slightly more than the expected rates of return despite charging much less than originally envisaged for non-aluminum consumption. However, these returns are somewhat overestimated because most of the resettlement expenditures are omitted from capital costs; moreover, strict comparison with other utilities would require full revaluation of book values of capital expenditures to allow for interim inflation. There are also some negative environmental effects, but presently of very unclear dimensions.

8.03 VRA and the Government are now aiming at earning an 8% rate of return on VRA's net fixed assets, as recommended by the Bank for ECG. After the Bank expressed its concern in 1968 about the low tariffs charged by VRA to ECG and recommended a review of VRA's tariff structure, VRA engaged consultants, Preece Cardew and Rider, to review the original power cost allocation studies previously undertaken by KECI and VRA and to make recommendations. A preliminary report in 1969 indicated that any tariff adjustment would be either small or not necessary. The final report, issued in 1970 and based on the 8% return assumption, has recommended, according to VRA's management, tariff increases similar to those computed by VRA itself; it suggested, in particular, that the VALCO tariff be increased to 3 mills/kwh, implying renegotiation of the 30-year power contract. After consideration by VRA and the Government, all tariffs except VALCO's were increased during 1971; tariffs to ECG were increased by about 20% on average.

8.04 The completed power plant at Akosombo is expected to meet market requirements until 1977. To meet increased demand from VALCO for a possible fifth pot-line and also the increased demand from the normal growth

of ECG and other consumers, VRA has been investigating various potential hydro developments in Ghana and is considering other possibilities -- such as importing power from Nigeria through Togo and Dahomey or the installation of thermal capacity. Ghana does not have any known indigenous fuel resources, but a thermal solution would avoid the environmental problems which may be characteristic of dams in West Africa. VRA is also planning the extension of its transmission network.

8.05 Prospects for the power sector are good. Net foreign exchange earnings from the combined hydroelectric/aluminum project (including savings made by meeting non-smelter demand from Akosombo rather than from a thermal plant) have probably been positive, and will increase when Ghana's own bauxite deposits are exploited. The availability of a large source of cheap power has allowed ECG to decrease its tariffs, in particular the tariffs for industrial consumption which has developed rapidly after 1966 with the establishment of small industries in Tema. Through payment of dividends to the Government in the coming years and of indirect taxes as of 1971 (import duties, excise taxes, sales and purchase taxes, surcharge on procurement, levy on interest payments abroad, from all of which VRA had been previously exempt), the sector will contribute to an increasing extent to the Government's general development expenditures; this would be justified because of the Government's relatively heavy investment in the power sector which presently directly benefits only about 16% of the population.

8.06 The scope of this study has been confined to evaluating achievement of the direct objectives of the Bank's loan for the Volta hydroelectric project. The VRA case raises important economic, social and ecological issues which deserve further investigation. The actual and potential multi-purpose aspects of the project -- transport, fishing and irrigation -- would have warranted more consideration. The institutional, administrative and financial measures required to prevent or to remedy negative social and environmental effects of the project would seem to have merited more attention from the Bank, as integral parts of the project -- especially in view of the great delays and unsatisfactory conditions which have actually beset the resettlement program. Partly because of the large social costs involved it remains an open question whether benefits of the project to Ghana have been commensurate with its costs. This, and the division of benefits on the whole scheme between Ghana and the international aluminum company, warrant further study.

GHANA THE VOLTA RIVER AUTHORITY

TABLE II-B

VRA PROJECT PARTLY FINANCED BY IBRD (US\$ million)

LOAN 310-GH (February 1962)

	PROJECT FINANCING ^{a/}				PERIOD 1966-1970			
	FORECAST		ACTUAL		FORECAST		ACTUAL	
	Total	% of total	Total	% of total	Total	% of total	Total	% of total
<u>SOURCES OF FUNDS</u>								
1. Net Internal Cash Generation	--	--	--	--	7.45	100	2.34	11
2. Domestic contribution:								
from public sector	69	41	57.18	42	--	--	.29	1
from private sector	--	--	--	--	--	--	--	--
Total	69	41	57.18	42	--	--	.29	1
3. Foreign Borrowing: ^{b/}								
Ex-Im. Bank	10	6	8.27	6	--	--	--	--
US AID	27	16	21.37	16	--	--	9.76	46
UK ECGD	14	9	3.45	2	--	--	.39	2
IBRD	47	28	46.66	34	--	--	7.26	34
CIDA	--	--	--	--	--	--	1.23	6
Total	98	59	79.75	58	--	--	18.64	88
4. Total Sources	<u>167</u>	<u>100</u>	<u>136.93</u>	<u>100</u>	<u>7.45</u>	<u>100</u>	<u>21.27</u>	<u>100</u>
<u>APPLICATIONS OF FUNDS</u>								
5. Total Fixed Investments	159.3	95	131.19	96	3.67	49	16.56	78
6. Working Capital and Cash	7.7	5	5.74	4	3.78	51	4.71	22
7. Total Applications	<u>167</u>	<u>100</u>	<u>136.93</u>	<u>100</u>	<u>7.45</u>	<u>100</u>	<u>21.27</u>	<u>100</u>
8. Debt Service	--	--	--	--	31.24	--	29.75	--

a/ Not including expenditure incurred by the Government (\$ 29 million forecast) for reservoir clearance, resettlement and access roads.

b/ Terms of Loans: Interest(%), Amortization(yrs)

Ex-Im. Bank	5 3/4	25
US AID	3 1/2	30
UK ECGD	6	25
IBRD	5 1/2	25
CIDA (thru Govt)	2 1/2	30

The CIDA loan was in a first phase made to the Government with 0% interest and 50 years repayment.

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GHANA THE VOLTA RIVER AUTHORITY

TABLE I

	Unit	1965	1966	1967	1968	1969	1970	Av. an. inc. rate(%) 1967-1970
OPERATIONS								
1. Installed Capacity (yr-end)	MW	588	588	588	588	588	588	
as % of Total in Country	%	82	82	83	83	83	84	
2. Peak-demand on VRA a/	MW	73	92	317	329	359	378	6.0
3. Gross Reserves	MW	n.a.	420	271	247	215	201	
Reserves as % of Peak-demand	%	--	456	85	78	62	55	
4. Effective-peak Spare Capacity	MW	--	337	170	73	157	115	
5. Gross Generation	GWh	104	477	1495	2521	2728	2882	24.4
6. Generation Sent Out	GWh	102	476	1493	2521	2726	2879	24.4
7. Total Sales	GWh	98	450	1454	2473	2674	2806	24.5
of which: to VALCO (in %)	%	--	3	63	75	74	72	
to ECG (in %)	%	84	67	25	17	19	20	
8. Number of Employees b/	No	960	671	781	930	978	n.a.	
9. Plant Factor	%	7.2	9.3	29.0	49.0	53.0	55.9	
10. Load Factor	%	55.0	56.3	52.3	85.8	85.0	84.7	
FINANCES								
11. Sales Revenues c/	N\$mln	.71	3.09	6.08	9.48	10.56	11.63	24.2
of which: from VALCO (in %)	%	--	1.8	38.0	52.7	50.0	46.3	
from ECG (in %)	%	64.2	68.8	43.6	33.5	36.3	39.1	
12. Operating Costs d/	N\$mln	.29	1.91	5.31	5.37	5.34	5.83	3.2
13. Average Revenue/kwh Sold	N\$	.72	.65	.42	.38	.39	.41	0
14. Average Cost/kwh Sold	N\$	.30	.42	.36	.22	.20	.21	-19.7
15. Average Revenue/kwh Sold	US\$	1.01	.97	.41	.37	.38	.40	0
16. Revenue/kwh Sold to VALVCO	US\$	--	.57	.23	.26	.26	.26	0
17. Revenue/kwh Sold to ECG	US\$	1.02	.99	.72	.74	.75	.79	3.1
18. Average Cost/kwh Sold	US\$	.42	.59	.35	.22	.20	.21	-19.7
19. Exchange Rate Used (Cedi)	US\$1=N\$	.71	.71	1.02	1.02	1.02	1.02	
20. Net Revenues (11-12)	N\$mln	.42	1.18	.77	4.11	5.22	5.80	96.1
21. Gross Fixed Investment	N\$mln	n.a.	7.44	1.41	1.07	1.35	2.44	--
22. Aver. Net Fixed Assets in Service	N\$mln	95.62	110.33	127.81	139.43	136.80	134.39	1.7
MANAGEMENT INDICATORS								
23. Rate of Return (20 as % of 22)	%		1.1	.6	2.9	3.8	4.3	
24. Debt Service Coverage e/	times	n.a.	4	.9	1.2	1.3	1.3	
25. Debt/Equity Ratio	./.	44/56	47/53	55/45	56/44	54/46	53/47	
26. Energy Sales per Employee	MWh	102	671	1862	2659	2734	n.a.	21.2
27. Distribution Losses (6-7/6)	%	4.0	5.5	2.6	1.9	1.9	2.5	
28. Average Capacity Out of Service as % of Installed Capacity f/	%	n.a.	4.7	17.0	7.5	4.3	7.9	
29. Resettlement Rate h/	%	63.5	61.2	60.2	60.2	69.7	74.1	
ECONOMIC INDICATORS								
30. Aluminum Exports by VALCO	tons000's	--	--	39	116	113	103	38.3
31. VALCO Power Payments as % Debt Service g/	%	--	1.7	45.8	74.6	76.0	75.6	
32. VRA Sales to ECG as % of Total Energy Sent Out by ECG	%	26.9	90.4	92.4	92.0	96.0	96.7	
33. Average Revenue/kwh in ECG	N\$	3.4	3.2	3.1	2.9	2.9	2.8	
34. ECG Revenue/kwh sold residential	N\$	2.7	2.6	2.5	2.5	2.5	2.5	--
35. ECG average revenue/kwh sold to industries	N\$	3.0	2.6	1.8	1.9	1.8	1.7	
36. Number of ECG Customers	000's	n.a.	77.8	84.3	89.5	94.7	99.33	6.3
37. ECG Total Sales Gwh	GWh	234	267	317	391	452	521	18.0
38. ECG Industrial Sales	GWh	50.3	56.7	89.0	144.7	181.6	222.9	35.9

a/ Maximum coincident demand in the year.

b/ For power activities only. Does not include labor force employed for construction of the hydroelectric plant and for resettlement.

c/ Revenues from sales of electric power only. Consumers of ECG or VRA do not pay indirect taxes.

d/ Including depreciation, but excluding interest. VRA does not pay income tax.

e/ Times debt service was covered by operating income (including non-power revenues) and depreciation.

f/ Capacity out of service only for programmed maintenance and breakdowns.

g/ Power payments made by VALCO in US\$ expressed as % of total VRA debt service (foreign exchange).

h/ Defined as cumulative number of resettlement houses built as % of cumulative number of households displaced from the lake basin.

GHANA THE VOLTA RIVER AUTHORITY
LOAN 310-GH (February, 1962)

TABLE II-A

	1965	1966	1967	1968	1969	1970	Av. an. inc. rate (%) 1965-1970
<u>LOAD FORECASTS (MW)</u>							
1. Firm Capacity ^{a/}	--	442	442	442	442	442	-- ^{i/}
Maximum demand:							
VALCO	--	--	166	223	223	223	10.3 ^{i/}
ECG ^{b/}	--	74	86	96	109	121	13.1
Mines	--	11	13	15	17	19	14.6
Total	--	85	265	334	349	363	43.8
2. Spare Capacity (1-2)	--	357	177	108	93	79	
<u>ACTUAL LOAD (MW)</u>							
4. Effective-peak capacity ^{c/}	n.a.	409	400	390	500	475	
Maximum demand:							
VALCO	--	5	220.5	220	245	250	4.3 ^{i/}
ECG ^{b/}	59.2	60.0	74.8	77.9	98.5	111.2	13.4
Mines ^{d/}	14.2	26.1	27.1	28.5	31.8	33.5	18.7
Total ^{d/}	73.4	91.1	322.4	326.4	375.3	394.7	40.0
5. Effective-peak spare capacity	n.a.	337.0	170.0	73.0	157.0	115.0	
<u>LOAD FORECAST ACCURACY^{e/}</u>							
7. Maximum demand:							
VALCO	--	--	75	101	91	89	
ECG ^{b/}	--	123	115	123	111	109	
Mines	--	42	48	53	53	57	
Total	--	93	82	102	93	92	
<u>SALES FORECASTS (Gwh)</u>							
8. Sales:							
VALCO	--	--	434	1242	1680	1752	59.1 ^{i/}
ECG ^{b/}	--	332	387	437	493	555	13.7
Mines	--	52	63	74	84	95	16.3
Total	--	384	884	1753	2257	2402	50.0
<u>ACTUAL SALES (Gwh)</u>							
9. Sales:							
VALCO	--	13.9	923.2	1865.9	1972.2	2012	29.6 ^{i/}
ECG ^{b/}	85.0	308.6	366.6	428.9	515.9	586	47.1
Mines	13.2	127.2	164.1	177.4	185.5	206	12.8
Total	98.2	449.7	1453.9	2473.2	2673.6	2806	50.0
<u>SALES FORECAST ACCURACY^{e/}</u>							
10. Sales to VALCO	--	--	47	67	85	87	
to ECG	--	107	105	102	96	95	
to Mines	--	41	38	42	45	46	
Total Sales	--	85	61	71	84	86	
<u>RETURN FORECAST (N%mln)</u>							
11. Operating Revenues:							
VALCO	--	--	1.16	3.32	4.50	4.69	59.1 ^{i/}
ECG	--	5.07	5.92	6.69	7.55	8.50	13.8
Mines	--	.54	.64	.75	.86	.96	15.5
Total	--	5.61	7.73	10.77	12.91	14.15	26.0
12. less: Operating Costs	--	2.34	6.95	6.95	6.95	6.95	31.3
13. Net Revenues	--	3.27	.78	3.82	5.96	7.20	21.8
14. Net Earnings ^{f/}	--	3.27	-4.37	-1.18	1.11	2.62	
15. Rate of return (%) ^{g/}	--	--	.4	1.9	3.0	3.7	
16. Net earnings as % Ghana investments ^{h/}	--	--	--	--	1.0	2.3	
<u>ACTUAL RETURN (N%mln)</u>							
17. Net Revenues rate of return-see Table I							
18. Net Earnings ^{f/}	.42	1.18	-3.23	.02	1.30	2.03	
19. Net Earnings as % Ghana investments ^{h/}	.59	1.63	--	.03	1.79	2.80	
<u>RETURN FORECAST ACCURACY^{e/}</u>							
20. Operating Revenues:							
VALCO	--	--	50	66	85	87	
ECG	--	162	219	205	192	183	
Mines	--	45	60	62	64	60	
Total	--	127	127	114	122	122	
21. Operating Costs	--	86	131	129	130	119	
22. Net Revenues	--	194	101	93	114	124	

a/ Defined as installed capacity minus one Unit as reserve.

b/ Including Akosombo township (about 1.5 MW) and textile factory (1MW as of 1968).

c/ Effective peak: critical time in the year when margin between demand and available capacity (after maintenance and loss due to water level) is least.

d/ Non coincident total maximum demand.

e/ Defined by the ratio Forecast/Actual.

f/ Defined as Net Revenues less interest charges.

g/ Net Revenues as % of average net fixed assets in service.

h/ Ghana total investments were N\$ 71.4mln in 1965 and 72.50mln afterwards.

i/ Average annual rate of increase over 1967-1970.

GHANA THE VOLTA RIVER AUTHORITY

TABLE II-B

VRA PROJECT PARTLY FINANCED BY IBRD (US\$ million)

LOAN 310-GH (February 1962)

	PROJECT FINANCING ^{a/}				PERIOD 1966-1970			
	FORECAST		ACTUAL		FORECAST		ACTUAL	
	Total	% of total	Total	% of total	Total	% of total	Total	% of total
<u>SOURCES OF FUNDS</u>								
1. Net Internal Cash Generation	--	--	--	--	7.45	100	2.34	11
2. Domestic contribution:								
from public sector	69	41	57.18	42	--	--	.29	1
from private sector	--	--	--	--	--	--	--	--
Total	69	41	57.18	42	--	--	.29	1
3. Foreign Borrowing: ^{b/}								
Ex-Im. Bank	10	6	8.27	6	--	--	--	--
US AID	27	16	21.37	16	--	--	9.76	46
UK ECGD	14	9	3.45	2	--	--	.39	2
IBRD	47	28	46.66	34	--	--	7.26	34
CIDA	--	--	--	--	--	--	1.23	6
Total	98	59	79.75	58	--	--	18.64	88
4. Total Sources	167	100	136.93	100	7.45	100	21.27	100
<u>APPLICATIONS OF FUNDS</u>								
5. Total Fixed Investments	159.3	95	131.19	96	3.67	49	16.56	78
6. Working Capital and Cash	7.7	5	5.74	4	3.78	51	4.71	22
7. Total Applications	167	100	136.93	100	7.45	100	21.27	100
8. Debt Service	--	--	--	--	31.24	--	29.75	--

a/ Not including expenditure incurred by the Government (\$ 29 million forecast) for reservoir clearance, resettlement and access roads.

b/ Terms of Loans: Interest(%), Amortization(yrs)

Ex-Im. Bank	5 3/4	25
US AID	3 1/2	30
UK ECGD	6	25
IBRD	5 1/2	25
CIDA (thru Govt)	2 1/2	30

The CIDA loan was ~~originally~~ in a first phase made to the Government with 0% interest and 50 years repayment.

GHANA THE VOLVA RIVER AUTHORITY
I.B.R.D. PROJECTS IMPLEMENTATION

TABLE III

	Start Construct.	Commis- sioning Date	Construct. Period (mths)	Project Scope	a/ CONSTRUCTION COST (US\$ million)	CONSTRUCTION COST		COST/KW US\$	
						L.C.	F.X.		Total
<u>LOAN 310-GH (of US\$ 47 million)</u> (Signed February 1962)						L.C.	F.X.	Total	
Volta River Plant b/	Forecast June 1961	Apr 1966	58	588MW	Hydro	61.6	67.1	128.7	219
	Actual Dec 1961	65-Ju66	46-55	588MW		50.33	72.36	122.69	209
Associated Transmission	Forecast Feb 1962	Nov 1964	33	985km	1,045km	9.9	28.8	38.7	
	Actual Oct 1962	65-Ju66	28-44	588MW		6.23	20.13	26.36	
Total Plant and Transmission b/	Forecast June 1961	Apr 1966	58	588MW	985km	71.5	95.9	167.4	285
	Actual Dec 1961	June 1966	55	588MW	1045km	56.56	92.49	149.05	253

LOAN DISBURSEMENT PATTERN

		1963	1964	1965	1966	1967	1968	1969	1970	Undisbur. 12/31/70	
<u>310-GH</u>	Forecast:	none									
	Actual:	Amount (US\$mLn)	9.89	16.22	13.59	5.56	1.40	.24	--	.10	--
		% of total	21.1	34.5	28.9	11.8	3.0	.5	--	.2	--
		Cumulative %	21.1	55.6	84.5	96.3	99.3	99.8	--	100	--

a/ Project scope is Megawatts of installed capacity and source of energy in the case of Generation projects, and kilometers of lines erected (165kv) in the case of transmission items (MVA capacity of substations was not available).

b/ Both forecast and actual include, on account of resettlement, only the NØ 7 million which, under the original Loan Agreement, were to be charged to the scheme. In the original estimates this was equivalent to US\$ 9.8 million; the dollar equivalent of actual expenditures on this particular item cannot be determined because it is not shown separately in the time stream of VRA investment.

Report No. Z-17/4¹⁷

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INTERNATIONAL BANK FOR RECONSTRUCTION & DEVELOPMENT⁵³

OPERATIONS EVALUATION REPORT: ELECTRIC POWER⁴⁵

CASE STUDY: VRA, GHANA²²

March ~~15~~, 1972¹⁰

Programming & Budgeting Department
Operations Evaluation Division

Currency Equivalents ²¹

	<u>Before 1967</u>	<u>1967 - 1971</u>	<u>1972</u>
1 New Gedi (N¢) = US\$	1.40	0.98	0.78
1 US\$ = N¢	0.71	1.02	1.28

- ① ~~Seyba~~
- ② ~~Furnas~~
- ③ ~~Ethiopia EELPA~~
- ④ ~~VRA Ghana~~
- ⑤ ~~Malaysia MEB~~
- ⑥ ~~Mexico CFE~~
- ⑦ ~~Singapore PUB~~

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1960



1970

I. INTRODUCTION

~~CHAPTER I - INTRODUCTION~~

~~CHAPTER V VRA GHANA~~

I. Introduction

1.01 The Volta River Authority (VRA) was established by the Volta River Development Act of 1961 to construct and operate the Volta River Project, which was built between 1962 and 1965 and partially financed by Bank Loan 310 GH. The delegations of policy laid down in the Act, which was reviewed by the Bank prior to passage, enable the Authority to take any action required for the success of the Volta River project and require it to conduct its affairs in accordance with sound public utility practices. Under the Act, the Authority is empowered to go well beyond the boundaries of the power sector, making it an integrated regional development agency. The creation of the Volta Lake opened up the possibility of the development of water transportation and fisheries. VRA is also responsible for general medical research and promotion of the well-being of the population in the area. It is administered by a seven-man Board of Directors appointed for terms of three years; ~~the President of the Republic is Chairman ex officio;~~ the other members include the Chief Executive of VRA, the Managing Directors of the Electricity Corporation of Ghana (ECG) and of the Volta Aluminum Company (VALCO), and four members representing the general public.

1.02 The Volta River hydroelectric station, located at Akosombo, has four 147 MW units installed since 1966. VRA owns and operates an 800 km, 165 kv transmission ring serving the VALCO smelter (built in connection with the project), ECG systems in the main towns, a number of smaller towns and villages, and gold and diamond mines. Since 1966 discussions had taken place between VRA and Togo and Dahomey for purchases

of VRA power by them. The power agreement between the three countries was signed in August 1969 and the transmission line from Akosombo to Lome (Togo) and Cotonou (Dahomey) is expected to be in service ^{in 1992} ~~by end-1971~~.

1.03 Almost all consumption of publicly supplied electricity occurs in the southern part of the country where about two-thirds of the total population lives, and where the bulk of commercial agriculture, manufacturing and all mining is located. Public generation, transmission and distribution of power are the responsibility of two organizations, VRA and ECG. The principal private producers of power, the mines, have placed their generating equipment on standby and use power produced by VRA. ECG is responsible for distribution of VRA power in southern Ghana and for the generation and distribution of diesel power in areas that cannot as yet be economically connected to the VRA transmission system.

II. The Association Between the Bank and the Authority

2.01 The Volta River Authority received two loans from the Bank as follows:

Loan No.	Date of Loan Agreement	Effective Date	Closing Date	Amounts (\$ mln.)		Interest	Period (years)	
				Committed	Disbursed ^{a/}		Grace	Term
310 GH	2/62	2/62	4/71 ^{b/}	47.0	47.0	5-3/4%	6	25
618 GH	6/69	10/69	12/73	6.0	2.9	6-1/2%	10	25
				<u>53.0</u>	<u>49.9</u>			
					47.05			

a/ As of December 31, 1970¹.

b/ Original closing date was June 1967 and was extended twice.

2.02 After several years of complex preparation and negotiations, Loan 310 GH was made to assist in financing the Volta River Authority Hydroelectric Project (with four units installed totalling 588 MW) and transmission facilities to permit bulk sales to VALCO's smelter, several large mining enterprises, and the Electricity Corporation of Ghana (ECG). The United Kingdom Export Credit Guarantee Department (ECGD), and the United States Export-Import Bank (Ex-Im) and Agency for International Development (AID) also provided loans aggregating US\$ 51 million equivalent (see Section III below for a more complete history of the loan). The power project was supposed to be completed by mid-1966 in order to supply power to the aluminum smelter of VALCO which had negotiated with VRA a ^{30-year} ~~long-term~~ contract for firm power ~~during 30 years~~ and was committed to build the aluminum smelter.

2.03 The Loan and Guarantee Agreement provided, in addition to the usual clauses regarding long-term debt incurrence and engagement of independent auditors, that:

- a) withdrawals from the loan funds (including U.S. and U.K. loans) would not at any time exceed 50% of the amount expended on the project;
- b) VRA would not change the rate for power sales in the contract between the Authority and VALCO without the Bank's agreement;
- c) the Government would undertake to reorganize the existing Electricity Division of the Ministry of Works and Housing (the predecessor of ECG) as a statutory corporation not later

than the date when the Volta River Authority was ready to sell power.

The terms of the loan contained also a performance target, to be met only by 1974, of an 8% return, from power operations, calculated after payment of interest, on the Government's equity.

2.04 The project was essentially completed by mid-1965 and totally by mid-1966; initial sales of power to ECG and mines started late in 1965 and to the smelter in March 1967. Three pot-lines had been installed in the smelter by 1967 and VALCO started negotiations to finance a fourth pot-line. VRA's contractual obligations to serve increasing demand from the smelter have required it to install additional generating capacity by April 1972 at the latest. In 1969 VRA requested the Bank to help finance the final two units, which would bring the power plant to its ultimate capacity of 882 MW, and associated substation facilities. Conditions of effectiveness for the loan prepared by the Bank were that the Canadian Government's loan to VRA be also effective and that VALCO make satisfactory arrangements to finance the expansion of its smelter. Loan 618 GH of US\$ 6 million equivalent became effective in October 1969. All major contracts have been awarded; ~~and~~ civil works ~~have~~ started some weeks behind schedule. It is anticipated that the additional units will be in operation on schedule.

III. The Genesis of the Project

3.01 Development of the Volta River basin in Ghana has been the subject of many studies from time to time since ~~1915 when~~ the discovery

The end of the 19th century.

of bauxite ^{in 1915} first directed attention to the possibility of generating hydroelectricity from the Volta to produce aluminum from local ore. Following a study in 1951 by engineering consultants recommending the development of an integrated aluminum scheme supplying the sterling area, the Gold Coast Government set up in 1953 a Preparatory Commission to follow up the work already done and to examine the problems to be overcome. The Commission reported in 1956, outlining a broad plan for a power plant at Ajena, bauxite mining and associated railways, an aluminum smelter of ^{120,000} ~~210,000~~ tons ^{initial} ~~final~~ annual capacity, and a port at Tema; ^{total cost of the plan was estimated at \$600 million in a first stage.} Power was estimated to be produced at the equivalent of 3 mills/kwh (US\$ 0.003) which was the maximum price the prospective aluminum companies had agreed to pay. Construction of the port began soon after, but otherwise there was little progress in the years immediately following this report, partly because of the large amount of finance required, partly because the country was about to become independent as Ghana, and partly because of the discouraging world outlook for aluminum at that time. First approaches and visits to the Bank had been made during 1953-1956 by the Preparatory Commission which saw a possible role for the Bank as provider of finance for power generation and protector of the private aluminum companies involved (Aluminum Ltd. of Canada and British Aluminum Co.). A first Bank mission sent in early 1957 to review economic conditions in Ghana questioned the advisability of undertaking the project at that time.

3.02. The Government of Ghana maintained their interest in the Volta scheme, which was made a keystone of national policy, and in 1957

approached the U.S. for possible assistance in bringing the project back to life. U.S. officials studied the project and asked for a review to be made. The engineering aspects of the power project were reappraised in 1959 by a firm of consultants, Kaiser Engineers and Constructors, Inc. (KECI), in a study financed jointly by the Governments of Ghana and the U.S. The consultants' proposals were for a dam and a power station to be constructed at Akosombo, a more economical site than Ajena; they confirmed the necessity of developing a large industrial load to justify the large hydroelectric project and recommended the construction of ^{120,000 tons} an aluminum smelter adjacent to Tema, the new port area, approximately 70 km from the dam site and 20 km from

Accra. The project was made more attractive for ~~the foreign aluminum industry by scaling down investment requirements for power and bauxite~~ *financing by eliminating the capital cost of developing both the railway system and the bauxite mines plus the cost of build*

↓
doing an alumina plant, all through the support of alumina powder, total cost of the scheme was estimated at \$ 350 million.

~~transport.~~ Moreover, a substantial change was introduced in the project by including a national transmission network for carrying the surplus power of the Volta, with the result of spreading the burden of the investment in the dam and the power plant almost equally between the aluminum and non-aluminum consumers of power; power for aluminum was estimated to be produced at a cost of 2.5 mills per kwh.

3.03 The Government made an engineering contract in 1959 with KECI to draw up the project plans. During the same year, a consortium grouping Kaiser Aluminum and Chemical Corporation - KACC (leader), Alcan, Alcoa, Olin Mathieson and Reynolds formed the Volta Aluminum Company Ltd. (VALCO) to explore the possibility of establishing the

smelter. The Ghana Government discussed KECI and VALCO proposals with the Governments of the U.S. and the U.K., who both showed interest, and later asked the Bank to appraise the electric power aspects of the scheme.

3.04 In 1960, the Bank studied and reported upon Ghana's economy (Report EA-110a) and upon the power project (Report TO-249a). Preliminary comments on the merits of the Volta Project were not enthusiastic. The Bank estimated that Ghana's non-smelter power needs would be less than predicted by Kaiser and recommended building the transmission network to carry power to general consumers only later; the Bank's analyses, based on higher cost estimates and power prices of at least 3 and preferably 3.5 mills per kwh to the smelter, indicated that the returns on investment would be very inadequate during the earlier years of operation and too low in the long run "to be particularly attractive." In sending these reports to the Government the Bank also stressed that, if the project were to be undertaken, the public investment program should be kept within bounds and should concentrate on productive investments.

3.05 During the subsequent negotiations between Ghana and VALCO for a Master Agreement and a Power Contract, Ghana used the Bank report as a "bargaining tool" and suggested a power price of about 3.25 mills/kwh. The Bank, asked by Ghana to give its opinion on VALCO's offer of 2.5 mills/kwh with a 10-year tax holiday, did not endorse VALCO's offer

and strongly recommended Ghana to seek every possible means of compensating itself, in particular through taxation on VALCO, for the financial and income losses which would bear on the Volta Authority and the Government if Ghana decided to accept a low rate. At the same time, the Bank indicated that it would be prepared to make a loan of \$40 million for the project (excluding the transmission network), in view of the extreme importance attributed to the project by the Government.^{1/} After Kaiser considered withdrawal, Ghana and VALCO eventually agreed on 2.625 mills/kwh; the Bank insisted that this power rate be fixed for 30 years only instead of 50 years, with VALCO having the right to renew for 20 more years at a rate to be derived from an escalation formula suggested and worked out by the Bank. In the Master Agreement concerning the conditions under which VALCO would operate in Ghana, it was agreed that (i) Ghana and the Volta River Authority would build a dam and power plant and supply power to VALCO, (ii) VALCO would build a smelter and pay for Volta power in U.S. dollars with an obligation "to take or pay for" a minimum amount of power each year, and (iii) VALCO would be given a 10-year tax holiday and complete freedom in its operations. It was also agreed that VALCO would not process Ghanaian bauxite at first in order to reduce the amount of finance needed, but after 10 years it would get a special tax incentive for doing so; VALCO's shareholder-customers would provide VALCO with imported alumina

^{1/} It seems likely that Ghana was about to accept 2.5 mills/kwh and wanted to test the Bank's willingness to make a loan under such conditions.

and pay VALCO a tolling charge for the aluminum ingots to be bought in sufficient quantity to enable VALCO to meet its power commitments. All VALCO's imports and exports (aluminum) would be exempt from customs duties.

3.06 VALCO was then constituted as an operating company with 90% of its shares owned by KACC and 10% by the Reynolds Metals Company; other companies had departed from the consortium. To encourage these two companies to undertake the smelter project, the U.S. Government, which had taken a deep interest in Ghana's projects, agreed to help finance the smelter with a \$96 million loan from the Ex-Im Bank and to guarantee the \$32 million investment of the shareholders against political risks.

3.07 The Government of Ghana decided also to proceed with the extended transmission system in view of better prospects of demand for power from the gold mines, and to undertake a preliminary study^{1/} of a hydroelectric project at Bui (upstream from Akosombo) associated with a transmission network designed to supply power to the general market. At this stage the U.S. Government agreed to finance half of the \$14 million additional cost required for the transmission system, and the Bank agreed to increase its loan by \$7 million to finance the other half. The Volta River Development Act establishing VRA was reviewed

^{1/} An agreement was reached with the Government of the Soviet Union to undertake this study.

by the Bank before its enactment; the provision for a Chief Financial Officer with equal status to that of the Chief Executive of the Authority was removed so that the latter would have undivided authority over the staff.

3.08 Before all the agreements, conditional on one another, concerning the power project and the smelter were eventually signed in February 1962, the civil works contract for the dam had been awarded to Impresit (Italy) through international competitive bidding. Ghana asked the Bank and the U.S. and Canadian Governments to provide candidates for the position of the Chief Executive of the Volta River Authority. A Canadian engineer from the Ontario Hydroelectric Commission was recommended by Canada and appointed to the post. The Volta River project was satisfactorily built on below estimated costs and operations began in late 1965. Sales to the smelter started in early 1967 and aluminum exports from the smelter reached 113,000 tons in 1969.

3.09 Loan 310 GH which was the first loan made by the Bank to Ghana involved "risks which had to be and were taken," as it was put in the staff report on the project to the Bank's Board. The success of this project which was primarily built for the smelter was strongly dependent on uncertain non-smelter revenues which were expected to comprise at least 65% of total revenues. However, "even taking all the intangible benefits into account, the overall balance of costs and benefits to Ghana was on the positive side to only a modest extent"; the internal rate of return on Ghana's equity investment in the project

(over an assumed 50-year life) was estimated at about 8.2%, and the investment was expected not to provide significant positive returns before the early 1970's nor to offset the cumulative losses from not investing an equivalent amount in liquid holdings before the late 1970's. One benefit frequently ascribed to this type of project, namely cheap power for non-smelter consumers, was not expected since it was assumed and recommended by the Bank that the Authority would have to charge these consumers "the highest possible tariffs consistent with obtaining maximum revenues."^{1/} The risks of nationalization and political turmoil feared by Kaiser-VALCO and the Bank have not materialized up to now and the Authority has succeeded in getting slightly better returns than expected, while charging non-smelter consumers tariffs lower than recommended.

3.10 Ghana has however been faced with unexpected difficulties which did not come under the Bank's scrutiny until ^{a few years ago} ~~recently~~. Nearly 10 years after start of construction the full land and housing compensation and resettlement of the 80,000 people displaced from the lake basin ^{for which the Government assumed responsibility} has not been completed and has up to now been rather unsuccessful due mainly to the lack of proper organization and the lack of clear Government policy on land tenure. ^{Initial efforts} ~~First tentative~~ by the Government ^{Failed} ~~were unsuccessful~~. In 1967 the Government ^{entrusted as its agent} ~~gave~~ VRA authority to undertake a land clearing and resettlement project with the assistance of UNDP and FAO World Food Program. A National Committee on Resettlement Agriculture was not established until 1968. By the end of 1970 the cadastral survey for land acquisition was almost

^{1/} Quotations are extracted from the appraisal report.

completed and about 75% of displaced households were established in new houses (see Table I). The Bank has recommended that VRA be discharged from its resettlement responsibilities so that VRA deal only with power activity "to make it easier to ultimately merge VRA's and ECG's operations." Lakeside health hazards have increased, though VRA has been assisted by WHO in its control measures and its research. River blindness and rates of bilharzia in children are high in some areas, breeding of Simulium demnosium flies has increased due to the high constant river flows and indications of trypanosomiasis have been found. *The Bank has been assisting WHO in preparing a long-term project to control river blindness in an area encompassing Ghana. It also contemplates* ~~It has recently been suggested in the Bank that it~~ *ing* formulate and coordinate with WHO *ing* future *other disease control and* eradication projects and *might* consider financing them.

3.11 On the other hand, the foreign exchange earnings from VALCO's power payments (other earnings from the smelter are negligible) and the savings in foreign exchange resulting from not generating in thermal plants the energy required to meet the non-smelter demand have made a contribution to Ghana's balance of payments, exceeding total debt service on VRA for its foreign borrowing by some 50% according to rough estimates for 1970.^{1/} The effect of the project on the balance of payments is expected to improve when VALCO increases its purchases of power for the smelter's fourth pot-line and when the complementary bauxite mining project envisaged initially, postponed in 1961 and

^{1/} In 1970, VRA's debt service amounted to US\$ 7 million, VALCO's payments to US\$ 5.3 million; savings on thermal generation for non-smelter demand are estimated at US\$ 5.5 million, i.e. US\$ 4.1 million for fuel required to generate 790 GWh and US\$ 1.4 million total debt service on the foreign exchange cost of a 120 MW thermal plant.

presently under discussion between Ghana, Kaiser and IFC is completed.

IV. Demand Forecasting and Investment Planning

4.01 The market served by the project was expected to be the smelter, the mines and general consumers in the southern area of Ghana. Projections were made up to 1976 in order to assess the long-term effects of the project on Ghana's economy and finances. Because of their different characteristics, the features and expected and actual developments of these three demands are discussed separately.

4.02 According to the Master Agreement negotiated between the Government and VALCO, VRA was required to make available to the smelter 166 MW of capacity (before transmission losses) in the first year, expected to be 1967, and up to 334 MW in 1972 and thereafter. The agreement also provided VALCO with another option for earlier increases of capacity, and projections were made for each option. Because VALCO exercised its first option, only the corresponding projections have been considered in Table II-A.

4.03 The consulting engineers estimated that the electricity demand of the general consumers in southern Ghana would grow by more than 13% p.a. over 1966-1970, reaching 121 MW and 555 Gwh in 1970. As regards the gold mines, it was assumed that the transfer of this load from captive generation to the Authority's system would be a gradual process; power being essential to the mines' safety, the

mines would discontinue the operation of their own generating facilities as soon as they could satisfy themselves of the reliability of supplies from VRA.

4.04 Both in terms of power (MW) and energy (Gwh) the forecasts turned out conservative on the whole (Table II-A). Sales to the smelter, ECG and the mines were scheduled to start in 1967 and 1966 respectively; because construction was completed ahead of schedule, sales started in 1965 for ECG and the mines and in 1966 for VALCO. Sales to the mines were double the expected level because VRA power saved consumers the taxes on fuel for captive plants. VALCO's peak demand outgrew by more than 10% the power agreement's figures under the first option. ECG's peak demand was about 15% lower than expected, but energy sales to ECG were on the average similar to those forecast, the discrepancy originating from a higher ECG load factor due to higher industrial sales. The high demand has reflected the confidence of the mines in VRA supplies and the effective operation of the smelter which consumed after 1967 an amount of energy 25% higher than that established in the power contract.

4.05 Over the 1966-1970 period, revenues from VALCO, like sales thereto, were 25% above the forecast, and revenues from mines were higher by about two-thirds as compared to the forecast, but sales revenues from ECG were on average half the forecast level because the price charged to ECG by VRA was 7.5 mills/kwh against 15 mills/kwh assumed in the appraisal report; total sales revenues have been lower than expected by

about 18%. As expected, total VRA revenues have depended in large measure on the size of the non-smelter load and on the tariffs charged to non-smelter consumers. On the other hand, costs for operations and for depreciation have been lower than expected by more than 20% on average mainly due to construction cost savings. As a result, net revenues fell below the forecasts by about 8% on average but the apparent rate of return on average net fixed assets in service grew from ⁰1.6% in 1967 to 4.3% in 1970 as against ⁰2.4% and 3.7% respectively expected in the forecasts. Correspondingly, the apparent net earnings for the country (defined as the net revenues less interest charges) represented a higher return on Ghana's investments, 2.8% in 1970 as against 2.3% forecast. However, the returns on the assets and the earnings on investments are to some extent over-estimated because only the foreign exchange portion of the assets was revalued after the 1967 devaluation of the Ghanaian cedi and because the assets include only one-fourth of the resettlement cost caused by the project (paragraph 5.04).

4.06 The amount of capacity installed was decided on the basis of the firm capacity concept (installed capacity less one unit as reserve); excluding the reserve unit, the remaining spare capacity was expected to decrease from 357 MW in 1966 to 79 MW in 1970, indicating an excess of two units in 1966 and one unit in 1967. According to the effective-peak spare capacity criterion (spare capacity at the critical time in the year when margin between demand and available capacity is

least), it appears ex-post that the four units have been necessary since 1968 when the effective-peak spare capacity dropped down to 73 MW.

V. Financing of the Project

5.01 The Government of Ghana had arranged financing totalling US\$ 196 million to provide:

- a) \$190 million to meet the estimated cost of the 4-unit, 588 MW installation and to meet the resettlement cost;
- b) \$ 6 million to meet part of the estimated cost of a fifth unit (which would have been required in early 1969 if VALCO had exercised its option at the earliest date possible).

The Government was prepared to invest up to \$98 million as equity (including \$29 million for resettlement and reservoir clearance) and obtained an additional \$98 million by borrowing from U.S. and U.K. agencies and from the Bank (Table II-B). The Bank was expected to contribute 28% to total sources of funds required for the power project (excluding resettlement and reservoir clearance), the U.S. and U.K. agencies 22% and 9% respectively. It had been assumed that the equity contributions and the various loan funds would be drawn upon as required, on a pro-rata basis.

5.02 Because of the reduction in the cost of the power project, both the Government contribution and the withdrawals from the foreign bilateral tied loans were lower than forecast. Procurements from U.S.

manufacturers and the use of a local cost clause allowed withdrawals from U.S. loans to contribute the expected 22% to total sources of funds; but withdrawals from the U.K. tied loan contributed only 2%, the difference being offset by withdrawals from the Bank loan which took a greater share of the financing (34%). The Government contributed the expected share to the cost of the power project itself.

5.03 Resettlement capital expenditures had been estimated at N¢ 20.4 million to be met by the Government as equity. Resettlement up to 1967 was carried out by the Government and N¢ 21.1 million was spent on this aspect. Since 1967 an additional N¢ 4.7 million (of which about 60% for administration only) has been spent by VRA out of funds provided by the Government. Thus total resettlement expenses by the end of 1970 amounted to N¢ 25.8 million, and resettlement is still far from being completed. According to the Loan Agreement only N¢ 7 million of resettlement expenditures were charged to the scheme and included in VRA's gross fixed assets, the remaining expenses (about 75%) being taken over by the Government.

VI. Project Implementation and Cost

6.01 Construction of the Volta River hydroelectric plant and the transmission lines has been generally very satisfactory. Though construction started several months later than expected, the plant and the transmission lines were commissioned on schedule, due to a shorter construction period of the plant (reduction of 7 months on average). The transmission network was completed during 1965 and

1966, instead of by November 1964 as expected, but transmission to VALCO's smelter was commissioned in due time before first operation of the smelter.

6.02 The monetary inflation which has taken place in Ghana has made it necessary to readjust the figures of the actual and estimated costs of the project (excluding interest during construction). The forecast construction costs set up in Table III have been computed excluding the allowances which were made in the domestic currency component for escalation in the costs of labor, and the actual costs have been obtained by deflating the local expenditures incurred each year for the project by the Ghanaian cost-of-living index. The result suggests that the total cost of the project (including only one-fourth of the resettlement costs; para. 5.04) has been about \$18 million lower than estimated, savings originating mainly from the low bid received for the civil works contracts and from the transmission part of the project. The foreign exchange component of the plant was higher than estimated by about \$5 million, but its local cost component was reduced by about \$11 million equivalent. Substantial savings were made on transmission, on both local and foreign components. As a result, the unit capital cost of the plant has been \$209 per kw installed, and the unit cost for the whole scheme (plant and associated transmission) dropped from \$285 expected to \$253 actual.

VII. Development of the Institutions

7.01 The first Chief Executive of VRA was an engineer from the Ontario Hydroelectric Commission of Canada, assisted by an Indian

Financial Adviser and by a Chief Engineer and a Chief Accountant both appointed from Ontario Hydro. The remaining staff of the Authority were Ghanaians. In addition, 15 Ontario Hydro staff were attached, under a technical assistance contract, to VRA to initially operate the facilities and give on-site training. Complete operational responsibility was transferred in 1967 to the Ghanaians who had received good training and have satisfactorily operated the facilities since. The present Chief Executive, a Ghanaian previously Chief Engineer of the former Electricity Division, was appointed to his present position in 1966. Senior staff positions (except Director of Engineering) were filled with Ghanaians after contracts with foreign staff were not renewed by VRA because of the costs of these contracts. The Canadian Engineering Director left VRA in May 1971 and ~~will probably be~~ ^{has been} replaced by a Ghanaian. Senior staff is well-qualified, but the Authority has been short of qualified middle-level staff. The accounting department needed reorganization in order to improve its procedures and reduce unqualified staff. VRA agreed during the second loan negotiations to carry out a review of its operations, organization structure, accounting system and staffing policies. VRA engaged for this purpose the services of Ontario Hydro who submitted a report in early 1971; the consultant's recommendations are still being examined by VRA.

7.02 Similar weaknesses have existed in the accounting department of the Electricity Corporation of Ghana. Establishment of ECG, to which

the Government was committed under Loan 310 GH, was delayed because of political changes in Ghana and the time required to formulate the basic charter of the new corporation. The Government decree establishing the Corporation (ECG) was published in January 1967 and became effective in July 1967. The Chief Executive of VRA has been a member of its Board. ECG has received the assistance of engineering consultants (W. Lahmeyer of Germany) and of its auditors, Cooper Brothers (who are also VRA's auditors), for management consultancy and reorganization of its accounting system on a commercial basis. In 1968 ECG received an IDA credit of US\$ 10 million to cover the foreign exchange cost of a distribution expansion project; the distribution facilities were essential to meet power demands and to allow maximum use of VRA's energy to replace expensive diesel generation. *A second IDA credit of US\$ 7.1 million was made in 1971.* Because it was essential that distribution facilities ~~in~~ Ghana should keep pace with the development of generating facilities and because the bulk of ECG sales would come from its purchases of power from VRA, the ~~loan~~ ^{credits} to ECG ~~was~~ ^{were} a logical sequence to the Volta project and has ~~be~~ ^{been} expected to add materially to the profitability of VRA.

7.03 The Bank has continuously favored merger of the operations of VRA and ECG. Earlier proposals to merge the former Electricity Division with VRA did not materialize, mainly for political reasons, and ECG was established as a separate entity. Because of the heavy dependence of ECG on VRA power and of some possibilities of staff economies, consolidation of the two entities has continued to be considered. Recent efforts,

however, have been hampered by the existence of the non-power activities undertaken by VRA under its status of regional development agency. In addition to resettlement and lake research, VRA started in 1967 to operate a pilot transportation system on the Volta Lake with income losses in 1968 and 1969. The termination of this scheme in March 1970 by establishing, with Danish assistance, the Volta Lake Transport Company as a separate entity has been a first step toward making a merger of the two organizations possible.

VIII. Conclusion

8.01 The risks envisaged by the Bank when helping to establish VRA did not materialize significantly. All obligations undertaken by Ghana have been fulfilled and agreements respected. The VRA has been operating satisfactorily on the whole and VALCO and ECG have been well serviced. Except for some organizational and overstaffing problems caused by social and environmental responsibilities of VRA and from governmental pressures, and which are under study for future improvements, the management of VRA appears to have performed better than expected. Technical performance has been satisfactory, with small distribution losses and capacity out of service kept to a reasonable level. Financial indicators suggest an improving situation, though still fragile.

8.02 Mainly because of lower capital costs than expected, and partly because of higher sales than expected, VRA has apparently been able to earn slightly more than the expected rates of return despite

charging much less than originally envisaged for non-aluminum consumption. However, these returns are somewhat overestimated because most of the resettlement expenditures are omitted from capital costs; moreover, strict comparison with other utilities would require full revaluation of book values of capital expenditures to allow for interim inflation. There are also some negative environmental effects, but presently of very unclear dimensions.

8.03 VRA and the Government are now aiming at earning an 8% rate of return on VRA's net fixed assets, as recommended by the Bank for ECG. After the Bank expressed its concern in 1968 about the low tariffs charged by VRA to ECG and recommended a review of VRA's tariff structure, VRA engaged consultants, Preece Cardew and Rider, to review the original power cost allocation studies previously undertaken by KECI and VRA and to make recommendations. A preliminary report in 1969 indicated that any tariff adjustment would be either small or not necessary. The final report, issued in 1970 and based on the 8% return assumption, has recommended, according

to VRA's management, tariff increases similar to those computed by VRA itself; *it suggested, in particular, that the VALCO tariff be increased to 3 mills/kwh, implying renegotiation of the 30-year power contract.* ~~in particular, it is suggested that the VALCO tariff could rise from 2.625 mills/kwh to more than 3 mills/kwh, though~~ *After consideration by VRA and the Government, all tariffs except VALCO's this would imply the renegotiation of the 30-year power contract.* ~~Tariff increases are still under VRA and Government consideration.~~ *was increased during 1971; tariffs to ECG were increased by about 20% on average.*

8.04 The completed power plant at Akosombo is expected to meet

market requirements until 1977. To meet increased demand from VALCO for a possible fifth pot-line and also the increased demand from the normal growth of ECG and other consumers, VRA has been investigating various potential hydro developments in Ghana and is considering other possibilities -- such as importing power from Nigeria through Togo and Dahomey (~~possibly the most economical solution~~) or the installation of thermal capacity. Ghana does not have any known indigenous fuel resources, but a thermal solution would avoid the environmental problems which may be characteristic of dams in West Africa. VRA is also planning the extension of its transmission network.

8.05 Prospects for the power sector are good. Net foreign exchange earnings from the combined hydroelectric/aluminum project (including savings made by meeting non-smelter demand from Akosombo rather than from a thermal plant) have probably been positive, and will increase when Ghana's own bauxite deposits are exploited. The availability of a large source of cheap power has allowed ECG to decrease its tariffs, in particular the tariffs for industrial consumption, which has developed rapidly after 1966 with the establishment of small industries in Tema. ~~Through payment of direct taxes (to purchase taxes, surcharge on procurement, levy on interest payments abroad, from all of which VRA had been previously exempted in 1962 up to 1971) and dividends in the coming years to the Government,~~ ^{indirect taxes (import duties, excise taxes, sales and purchase taxes, surcharge on procurement, levy on interest payments abroad, from all of which VRA had been previously exempted in 1962 up to 1971)} the sector will contribute to an increasing extent to the Government's general development expenditures; this would be justified because of the Government's relatively heavy investment in the power sector which presently directly benefits

Through payment of dividends to the Government in the coming years and of indirect taxes as of 1971 (import duties, excise taxes, sales and purchase taxes, surcharge on procurement, levy on interest payments abroad, from all of which VRA had been previously exempted),

only about 16% of the population.

8.06 The scope of this study has been confined to evaluating achievement of the direct objectives of the Bank's loan for the Volta hydroelectric project. The VRA case raises important economic, social and ecological issues which deserve further investigation. ~~In connection with its financing of such a large source of cheap power the Bank might have done more to promote local industrial development.~~ The actual and potential multipurpose aspects of the project -- transport, fishing and irrigation -- would have warranted more consideration. The institutional, administrative and financial measures required to prevent or to remedy negative social and environmental effects of the project would seem to have merited ~~much~~ more attention from the Bank, as integral parts of the project -- especially in view of the great delays and unsatisfactory conditions which have actually beset the resettlement program. Partly because of the large social costs involved it remains an open question whether ~~the project's net benefits to Ghana have been positive, or whether it has benefitted more the Kaiser Corporation.~~ This should be studied.

benefits of the project to Ghana have been commensurate with its costs. This, and the division of ^{on the whole scheme} benefits between Ghana and the international aluminum company, warrant further study.

Vu

OFFICE MEMORANDUM

TO: Mr. Christopher R. Willoughby

DATE: March 14, 1972

FROM: Roger Chaufourmier *RC*SUBJECT: Review of Ghana Chapter

You asked for our review of the Ghana case study chapter of the Operations Evaluation report on power. Our comments and suggested revisions follow:

1. Para. 3.01 - It would be more accurate historically if this read:

"Development of the Volta River basin in Ghana has been the subject of many studies from time to time since the end of the 19th century. The discovery of bauxite in 1915 first directed..."

Surveys of the river and possible harbor developments began at least as early as 1895. The common references to 1915 relate to the beginning of the mineral studies of Sir Albert Kitson which led to the bauxite discovery.

2. Para. 3.02 - The fifth sentence would portray the main effect of the Kaiser study far better if it read:

"The project was made more attractive for financing by eliminating the capital cost of developing the national railway system plus the cost of developing the bauxite mines and building an alumina plant, all through the import of alumina powder."

The main achievement of the Kaiser study was to bring the Volta project's cost back to the level where potential financiers as well as customers could be involved.

3. Para. 3.10 - The last sentence should acknowledge the full scope of the Bank's activity in this sphere and read:

"The Bank has been assisting WHO in the preparation of a long-term project to control river blindness in an area encompassing Ghana. It is also contemplating the formulation and coordination with WHO of other future disease control and eradication projects ..."

.../

4. Para. 8.04 - VRA has been adamantly opposed to relying on any other country as a source for future power generation.

5. Para. 8.06 - In line with the nature of your request, we are leaving the more technical comments on the project in the case study to our associates in the Public Utilities Department who have followed this project for more years and with greater expertise than anyone in this Department. Despite that arrangement, however, we must express our reservations about the summary conclusion in this final paragraph. There is no question that broader considerations than those solely pertinent to power logically enter into an examination of the VRA case. This judgment provides little basis, however, for the comment about inadequate Bank promotion of local industrial development. The text does not support that conclusion or even the supposition that more could have been achieved.

cc - Mr. Wyatt

HJNissenbaum:crm

Vu

OFFICE MEMORANDUM

TO: Mr. Christopher R. Willoughby

DATE: March 15, 1972

FROM: E.A. Minnig *hm*

SUBJECT: Operations Evaluation Report on Power - VRA (Ghana)

With reference to your memorandum dated March 7, 1972 addressed to Mr. Mervyn L. Weiner on the above subject, please find attached a copy of Chapter V - VRA (pages 121-144) in which I have made my comments in red.

EAMinnig:cb
IBRD

cc: Messrs. Mervyn L. Weiner (with copy of attachment)
F.H. Howell (" " " ")
Gavin E. Wyatt (" " " ")

Division Files
Central Files

Ghana NRA

INTERNATIONAL DEVELOPMENT
ASSOCIATION

INTERNATIONAL BANK FOR
RECONSTRUCTION AND DEVELOPMENT

INTERNATIONAL FINANCE
CORPORATION

OFFICE MEMORANDUM

TO: Mr. Mervyn L. ~~Weiner~~ *FA*

DATE: March 7, 1972

FROM: Christopher R. Willoughby *CRW*

SUBJECT: Operations Evaluation Report on Power.

Please find attached the revised drafts of four of the 'case' studies chapters on each individual company part of the Power Review. You will receive within a few days the revised drafts of the chapters on the six remaining companies. These drafts take account of the comments which we received from your Department.

We envisage including a note in the main report to the effect that these case studies will be available on request to the Executive Directors.

We would appreciate it to have these studies once more reviewed by the staff of your Department. In order to expedite processing and enable us to keep on schedule, we have marked in red in the margin the sections of the Preliminary Draft dated 12/22/71 which were changed to take account of your previous comments. We would appreciate it if any further comments you might have could take the form of specific suggestions of changes to be made, and if they were to reach us by Wednesday, March 15th.

We are sending copies of these drafts also to the Area Departments with a request to check the references to countries and country policies.

*do bring
comments if you have any
to Willoughby please put in memo
Lucas & Howell with copy to
CRW*

CHAPTER V - VRA - GHANA

I. Introduction

1.01 The Volta River Authority (VRA) was established by the Volta River Development Act of 1961 to construct and operate the Volta River Project, which was built between 1962 and 1965 and partially financed by Bank Loan 310 GH. The delegations of policy laid down in the Act, which was reviewed by the Bank prior to passage, enable the Authority to take any action required for the success of the Volta River project and require it to conduct its affairs in accordance with sound public utility practices. Under the Act, the Authority is empowered to go well beyond the boundaries of the power sector, making it an integrated regional development agency. The creation of the Volta Lake opened up the possibility of the development of water transportation and fisheries. VRA is also responsible for general medical research and promotion of the well-being of the population in the area. It is administered by a seven-man Board of Directors appointed for terms of three years; ~~the President of the Republic is Chairman ex officio;~~ the ~~other~~ members include the Chief Executive of VRA, the Managing Directors of the Electricity Corporation of Ghana (ECG) and of the Volta Aluminum Company (VALCO), and four members representing the general public.

1.02 The Volta River hydroelectric station, located at Akosombo, has four 147 MW units installed since 1966. VRA owns and operates an 800 km 165 kv transmission ring serving the VALCO smelter (built in connection with the project), ECG systems in the main towns, a number of smaller towns and villages, and gold and diamond mines. Since 1966 discussions had taken place between VRA and Togo and Dahomey for purchases

of VRA power by them. The power agreement between the three countries was signed in August 1969 and the transmission line from Akosombo to Lome (Togo) and Cotonou (Dahomey) is expected to be in service ^{in 1972.} by ~~end-1971~~.

1.03 Almost all consumption of publicly supplied electricity occurs in the southern part of the country where about two-thirds of the total population lives, and where the bulk of commercial agriculture, manufacturing and all mining is located. Public generation, transmission and distribution of power are the responsibility of two organizations, VRA and ECG. The principal private producers of power, the mines, have placed their generating equipment on standby and use power produced by VRA. ECG is responsible for distribution of VRA power in southern Ghana and for the generation and distribution of diesel power in areas that cannot as yet be economically connected to the VRA transmission system.

II. The Association Between the Bank and the Authority

2.01 The Volta River Authority received two loans from the Bank as follows:

Loan No.	Date of Loan Agreement	Effective Date	Closing Date	Amounts (\$ mln.)		Interest	Period (years)	
				Committed	Disbursed ^{a/}		Grace	Term
310 GH	2/62	2/62	4/71 ^{b/}	47.0	47.0 ✓	5-3/4%	6	25
618 GH	6/69	10/69	12/73	6.0	3.3 0.05 50.3 47.05	6-1/2%	10	25
				<u>53.0</u>	<u>47.05</u>			

^{January} a/ As of ~~December~~ 31, 1970.

b/ Original closing date was June 1967 and was extended twice.

2.02 After several years of complex preparation and negotiations, Loan 310 GH was made to assist in financing the Volta River Authority Hydroelectric Project (with four units installed totalling 588 MW) and transmission facilities to permit bulk sales to VALCO's smelter, several large mining enterprises, and the Electricity Corporation of Ghana (ECG). The United Kingdom Export Credit Guarantee Department (ECGD), and the United States Export-Import Bank (Ex-Im) and Agency for International Development (AID) also provided loans aggregating US\$ 51 million equivalent (see Section III below for a more complete history of the loan). The power project was supposed to be completed by mid-1966 in order to supply power to the aluminum smelter of VALCO which had negotiated with VRA a ^{30 year} ~~long-term~~ contract for firm power ~~during 30 years~~ and was committed to build the aluminum smelter.

2.03 The Loan and Guarantee Agreement provided, in addition to the usual clauses regarding long-term debt incurrence and engagement of independent auditors, that:

- a) withdrawals from the loan funds (including U.S. and U.K. loans) would not at any time exceed 50% of the amount expended on the project;
- b) VRA would not change the rate for power sales in the contract between the Authority and VALCO without the Bank's agreement;
- c) the Government would undertake to reorganize the existing Electricity Division of the Ministry of Works and Housing (the predecessor of ECG) as a statutory corporation not later

than the date when the Volta River Authority was ready to sell power.

The terms of the loan contained also a performance target, to be met only by 1974, of an 8% return, from power operations, calculated after payment of interest, on the Government's equity.

2.04 The project was essentially completed by mid-1965 and totally by mid-1966; initial sales of power to ECG and mines started late in 1965 and to the smelter in March 1967. Three pot-lines had been installed in the smelter by 1967 and VALCO started negotiations to finance a fourth pot-line. VRA's contractual obligations to serve increasing demand from the smelter have required it to install additional generating capacity by April 1972 at the latest. In 1969 VRA requested the Bank to help finance the final two units, which would bring the power plant to its ultimate capacity of 882 MW, and associated substation facilities. Conditions of effectiveness for the loan prepared by the Bank were that the Canadian Government's loan to VRA be also effective and that VALCO make satisfactory arrangements to finance the expansion of its smelter. Loan 618 GH of US\$ 6 million equivalent became effective in October 1969. All major contracts have been awarded ^{but} and civil works have started some weeks behind schedule. It is anticipated that the additional units will be in operation on schedule.

III. The Genesis of the Project

3.01 Development of the Volta River basin in Ghana has been the subject of many studies from time to time since 1915 when the discovery

of bauxite first directed attention to the possibility of generating hydroelectricity from the Volta to produce aluminum from local ore. Following a study in 1951 by engineering consultants recommending the development of an integrated aluminum scheme supplying the sterling area, the Gold Coast Government set up in 1953 a Preparatory Commission to follow up the work already done and to examine the problems to be overcome. The Commission reported in 1956, outlining a broad plan for a power plant at Ajena, bauxite mining and associated railways, an aluminum smelter of 210,000 tons final annual capacity, and a port at Tema. Power was estimated to be produced at the equivalent of 3 mills/kwh (US\$ 0.003) which was the maximum price the prospective aluminum companies had agreed to pay. Construction of the port began soon after, but otherwise there was little progress in the years immediately following this report, partly because of the large amount of finance required, partly because the country was about to become independent as Ghana, and partly because of the discouraging world outlook for aluminum at that time. First approaches and visits to the Bank had been made during 1953-1956 by the Preparatory Commission which saw a possible role for the Bank as provider of finance for power generation and protector of the private aluminum companies involved (Aluminum Ltd. of Canada and British Aluminum Co.). A first Bank mission sent in early 1957 to review economic conditions in Ghana questioned the advisability of undertaking the project at that time.

3.02. The Government of Ghana maintained their interest in the Volta scheme, which was made a keystone of national policy, and in 1957

approached the U.S. for possible assistance in bringing the project back to life. U.S. officials studied the project and asked for a review to be made. The engineering aspects of the power project were reappraised in 1959 by a firm of consultants, Kaiser Engineers and Constructors, Inc. (KECI), in a study financed jointly by the Governments of Ghana and the U.S. The consultants' proposals were for a dam and a power station to be constructed at Akosombo, a more economical site than Ajena; they confirmed the necessity of developing a large industrial load to justify the large hydroelectric project and recommended the construction of an aluminum smelter adjacent to Tema, the new port area, approximately 70 km from the dam site and 20 km from Accra. The project was made more attractive for the foreign aluminum industry by scaling down investment requirements for power and bauxite transport. Moreover, a substantial change was introduced in the project by including a national transmission network for carrying the surplus power of the Volta, with the result of spreading the burden of the investment in the dam and the power plant almost equally between the aluminum and non-aluminum consumers of power; power for aluminum was estimated to be produced at a cost of 2.5 mills per kwh.

3.03 The Government made an engineering contract in 1959 with KECI to draw up the project plans. During the same year, a consortium grouping Kaiser Aluminum and Chemical Corporation - KACC (leader), Alcan, Alcoa, Olin Mathieson and Reynolds formed the Volta Aluminum Company Ltd. (VALCO) to explore the possibility of establishing the

smelter. The Ghana Government discussed KECI and VALCO proposals with the Governments of the U.S. and the U.K. who both showed interest, and later asked the Bank to appraise the electric power aspects of the scheme.

3.04 In 1960, the Bank studied and reported upon Ghana's economy (Report EA-110a) and upon the power project (Report TO-249a). Preliminary comments on the merits of the Volta Project were not enthusiastic.

The Bank estimated that Ghana's non-smelter power needs would be less than predicted by Kaiser and recommended building the transmission

network to carry power to general consumers only later; the Bank's

analyses, based on higher cost estimates and power prices of at least 3 and

preferably 3.5 mills per kwh to the smelter, indicated that the returns on

investment would be very inadequate during the earlier years of

operation and too low in the long run "to be particularly attractive."

In sending these reports to the Government the Bank also stressed

that, if the project were to be undertaken, the public investment

program should be kept within bounds and should concentrate on produc-

tive investments.

3.05 During the subsequent negotiations between Ghana and VALCO for a Master Agreement and a Power Contract, Ghana used the Bank report as a "bargaining tool" and suggested a power price of about 3.25 mills/kwh. The Bank, asked by Ghana to give its opinion on VALCO's offer of 2.5 mills/kwh with a 10-year tax holiday, did not endorse VALCO's offer

and strongly recommended Ghana to seek every possible means of compensating itself, in particular through taxation on VALCO, for the financial and income losses which would bear on the Volta Authority and the Government if Ghana decided to accept a low rate. At the same time, the Bank indicated that it would be prepared to make a loan of \$40 million for the project (excluding the transmission network), in view of the extreme importance attributed to the project by the Government.^{1/} After Kaiser considered withdrawal, Ghana and VALCO eventually agreed on 2.625 mills/kwh; the Bank insisted that this power rate be fixed for 30 years only instead of 50 years, with VALCO having the right to renew for 20 more years at a rate to be derived from an escalation formula suggested and worked out by the Bank. * In the Master Agreement concerning the conditions under which VALCO would operate in Ghana, it was agreed that (i) Ghana and the Volta River Authority would build a dam and power plant and supply power to VALCO, (ii) VALCO would build a smelter and pay for Volta power in U.S. dollars with an obligation "to take or pay for" a minimum amount of power each year, and (iii) VALCO would be given a 10-year tax holiday and complete freedom in its operations. It was also agreed that VALCO would not process Ghanaian bauxite at first in order to reduce the amount of finance needed, but after 10 years it would get a special tax incentive for doing so; VALCO's shareholder-customers would provide VALCO with imported alumina

^{1/} It seems likely that Ghana was about to accept 2.5 mills/kwh and wanted to test the Bank's willingness to make a loan under such conditions.

* The appraisal report on the project (Report TO-281 a) ^{August 1961} indicated that the forecast return on Ghana's equity investment in the Project over its 50-year life—calculated on a discounted cash flow basis with a smelter tariff of 2.625 mills/kwh—would vary between 4.2% - 8.8% depending on the inclusion or exclusion of Ghana's investments in ancillary facilities.

and pay VALCO a tolling charge for the aluminum ingots to be bought in sufficient quantity to enable VALCO to meet its power commitments. All VALCO's imports and exports (aluminum) would be exempt from customs duties.

3.06 VALCO was then constituted as an operating company with 90% of its shares owned by KACC and 10% by the Reynolds Metals Company; other companies had departed from the consortium. To encourage these two companies to undertake the smelter project, the U.S. Government, which had taken a deep interest in Ghana's projects, agreed to help finance the smelter with a \$96 million loan from the Ex-Im Bank and to guarantee the \$32 million investment of the shareholders against political risks.

3.07 The Government of Ghana decided also to proceed with the extended transmission system in view of better prospects of demand for power from the gold mines, and to undertake a preliminary study^{1/} of a hydroelectric project at Bui (upstream from Akosombo) associated with a transmission network designed to supply power to the general market. At this stage the U.S. Government agreed to finance half of the \$14 million additional cost required for the transmission system, and the Bank agreed to increase its loan by \$7 million to finance the other half. The Volta River Development Act establishing VRA was reviewed

^{1/} An agreement was reached with the Government of the Soviet Union to undertake this study.

by the Bank before its enactment; the provision for a Chief Financial Officer with equal status to that of the Chief Executive of the Authority was removed so that the latter would have undivided authority over the staff.

3.08 Before all the agreements, conditional on one another, concerning the power project and the smelter were eventually signed in February 1962, the civil works contract for the dam had been awarded to Impresit (Italy) through international competitive bidding. Ghana asked the Bank and the U.S. and Canadian Governments to provide candidates for the position of the Chief Executive of the Volta River Authority. A Canadian engineer from the Ontario Hydroelectric Commission was recommended by Canada and appointed to the post. The Volta River project was satisfactorily built on schedule and operations began in late 1965. Sales to the smelter started in early 1967 and aluminum exports from the smelter reached 113,000 tons in 1969. *below estimated with*

3.09 Loan 310 GH which was the first loan made by the Bank to Ghana involved "risks which had to be and were taken," as it was put in the staff report on the project to the Bank's Board. The success of this project which was primarily built for the smelter was strongly dependent on uncertain non-smelter revenues which were expected to comprise at least 65% of total revenues. However, "even taking all the intangible benefits into account, the overall balance of costs and benefits to Ghana was on the positive side to only a modest extent"; the internal rate of return on Ghana's equity investment in the project

(over an assumed 50-year life) was estimated at about 8.2%, and the investment was expected not to provide significant positive returns before the early 1970's nor to offset the cumulative losses from not investing an equivalent amount in liquid holdings before the late 1970's. One benefit frequently ascribed to this type of project, namely cheap power for non-smelter consumers, was not expected since it was assumed and recommended by the Bank that the Authority would have to charge these consumers "the highest possible tariffs consistent with obtaining maximum revenues."^{1/} The risks of nationalization and political turmoil feared by Kaiser-VALCO and the Bank have not materialized up to now and the Authority has succeeded in getting slightly better returns than expected, while charging non-smelter consumers tariffs lower than recommended.

3.10 Ghana has however been faced with unexpected difficulties, which ~~did not come under the Bank's scrutiny until recently~~. Nearly 10 years after start of construction the full land and housing compensation and resettlement of the 80,000 people displaced from the lake basin, ^{for which the Government assumed responsibility} has not been completed and ~~has up to now been rather unsuccessful~~ due mainly to the lack of proper organization and the lack of clear Government policy on land tenure. First tentatives by the Government were unsuccessful. In 1967 the Government ^{entrusted} gave VRA ^{as its agent} authority to undertake a land clearing and resettlement project with the assistance of UNDP and FAO World Food Program. A National Committee on Resettlement Agriculture was not established until 1968. By the end of 1970 the cadastral survey for land acquisition was almost

^{1/} Quotations are extracted from the appraisal report.

completed and about 75% of displaced households were established in new houses (see Table I). The Bank has recommended that VRA be discharged from its resettlement responsibilities so that VRA deal only with power activity "to make it easier to ultimately merge VRA's and ECG's operations." Lakeside health hazards have increased, though VRA has been assisted by WHO in its control measures and its research. River blindness and rates of bilharzia in children are high in some areas, breeding of Simulium demnosium flies has increased due to the high constant river flows and indications of trypanosomiasis have been found. It has recently been suggested in the Bank that it formulate and coordinate with WHO future eradication projects and consider financing them.

3.11 On the other hand, the foreign exchange earnings from VALCO's power payments (other earnings from the smelter are negligible) and the savings in foreign exchange resulting from not generating in thermal plants the energy required to meet the non-smelter demand have made a contribution to Ghana's balance of payments, exceeding total debt service on VRA for its foreign borrowing by some 50% according to rough estimates for 1970.^{1/} The effect of the project on the balance of payments is expected to improve when VALCO increases its purchases of power for the smelter's fourth pot-line and when the complementary bauxite mining project envisaged initially, postponed in 1961 and

^{1/} In 1970, VRA's debt service amounted to US\$ 7 million, VALCO's payments to US\$ 5.3 million; savings on thermal generation for non-smelter demand are estimated at US\$ 5.5 million, i.e. US\$ 4.1 million for fuel required to generate 790 GWh and US\$ 1.4 million total debt service on the foreign exchange cost of a 120 MW thermal plant.

presently under discussion between Ghana, Kaiser and IFC is completed.

IV. Demand Forecasting and Investment Planning

4.01 The market served by the project was expected to be the smelter, the mines and general consumers in the southern area of Ghana. Projections were made up to 1976 in order to assess the long-term effects of the project on Ghana's economy and finances. Because of their different characteristics, the features and expected and actual developments of these three demands are discussed separately.

4.02 According to the Master Agreement negotiated between the Government and VALCO, VRA was required to make available to the smelter 166 MW of capacity (before transmission losses) in the first year, expected to be 1967, and up to 334 MW in 1972 and thereafter. The agreement also provided VALCO with another option for earlier increases of capacity, and projections were made for each option. Because VALCO exercised its first option, only the corresponding projections have been considered in Table II-A.

4.03 The consulting engineers estimated that the electricity demand of the general consumers in southern Ghana would grow by more than 13% p.a. over 1966-1970, reaching 121 MW and 555 Gwh in 1970. As regards the gold mines, it was assumed that the transfer of this load from captive generation to the Authority's system would be a gradual process; power being essential to the mines' safety, the

mines would discontinue the operation of their own generating facilities as soon as they could satisfy themselves of the reliability of supplies from VRA.

4.04 Both in terms of power (MW) and energy (Gwh) the forecasts turned out conservative on the whole (Table II-A). Sales to the smelter, ECG and the mines were scheduled to start in 1967 and 1966 respectively; because construction was completed ahead of schedule, sales started in 1965 for ECG and the mines and in 1966 for VALCO. Sales to the mines were double the expected level because VRA power saved consumers the taxes on fuel for captive plants. VALCO's peak demand outgrew by more than 10% the power agreement's figures under the first option. ECG's peak demand was about 15% lower than expected, but energy sales to ECG were on the average similar to those forecast, the discrepancy originating from a higher ECG load factor due to higher industrial sales. The high demand has reflected the confidence of the mines in VRA supplies and the effective operation of the smelter which consumed after 1967 an amount of energy 25% higher than that established in the power contract.

4.05 Over the 1966-1970 period, revenues from VALCO, like sales thereto, were 25% above the forecast, and revenues from mines were higher by about two-thirds as compared to the forecast, but sales revenues from ECG were on average half the forecast level because the price charged to ECG by VRA was 7.5 mills/kwh against 15 mills/kwh assumed in the appraisal report; total sales revenues have been lower than expected by

about 18%. As expected, total VRA revenues have depended in large measure on the size of the non-smelter load and on the tariffs charged to non-smelter consumers. On the other hand, costs for operations and for depreciation have been lower than expected by more than 20% on average mainly due to construction cost savings. As a result, net revenues fell below the forecasts by about 8% on average but the apparent rate of return on average net fixed assets in service grew from .6% in 1967 to 4.3% in 1970 as against .4% and 3.7% respectively expected in the forecasts. Correspondingly, the apparent net earnings for the country (defined as the net revenues less interest charges) represented a higher return on Ghana's investments, 2.8% in 1970 as against 2.3% forecast. However, the returns on the assets and the earnings on investments ^{may} ~~are~~ to some extent ^{be} over-estimated because ~~only the foreign exchange portion of the assets was revalued after the 1967 devaluation of the Ghanaian cedi and because the assets include only one-fourth of the resettlement cost caused by the project~~ (paragraph 5.04).

4.06 The amount of capacity installed was decided on the basis of the firm capacity concept (installed capacity less one unit as reserve); excluding the reserve unit, the remaining spare capacity was expected to decrease from 357 MW in 1966 to 79 MW in 1970, indicating an excess of two units in 1966 and one unit in 1967. According to the effective-peak spare capacity criterion (spare capacity at the critical time in the year when margin between demand and available capacity is

least), it appears ex-post that the four units have been necessary since 1968 when the effective-peak spare capacity dropped down to 73 MW.

V. Financing of the Project

5.01 The Government of Ghana had arranged financing totalling US\$ 196 million to provide:

- a) \$190 million to meet the estimated cost of the 4-unit, 588 MW installation and to meet the resettlement cost;
- b) \$ 6 million to meet part of the estimated cost of a fifth unit (which would have been required in early 1969 if VALCO had exercised its option at the earliest date possible).

The Government was prepared to invest up to \$98 million as equity (including \$29 million for resettlement and reservoir clearance) and obtained an additional \$98 million by borrowing from U.S. and U.K. agencies and from the Bank (Table II-B). The Bank was expected to contribute 28% to total sources of funds required for the power project (excluding resettlement and reservoir clearance), the U.S. and U.K. agencies 22% and 9% respectively. It had been assumed that the equity contributions and the various loan funds would be drawn upon as required, on a pro-rata basis.

of which \$7 million were charged to JICA

5.02 Because of the reduction in the cost of the power project, both the Government contribution and the withdrawals from the foreign bilateral tied loans were lower than forecast. Procurements from U.S.

manufacturers and the use of a local cost clause allowed withdrawals from U.S. loans to contribute the expected 22% to total sources of funds; but withdrawals from the U.K. tied loan contributed only 2%, the difference being offset by withdrawals from the Bank loan which took a greater share of the financing (34%). The Government contributed the expected share to the cost of the power project itself.

5.03 Resettlement capital expenditures had been estimated at N \textasciitilde 20.4 million to be met by the Government as equity. Resettlement up to 1967 was carried out by the Government and N \textasciitilde 21.1 million was spent on this aspect. Since 1967 an additional N \textasciitilde 4.7 million (of which about 60% for administration only) has been spent by VRA out of funds provided by the Government. Thus total resettlement expenses by the end of 1970 amounted to N \textasciitilde 25.8 million, and resettlement is still far from being completed. According to the Loan Agreement only N \textasciitilde 7 million of resettlement expenditures were charged to the scheme and included in VRA's gross fixed assets, the remaining expenses (about 75%) being taken over by the Government.

VI. Project Implementation and Cost

6.01 Construction of the Volta River hydroelectric plant and the transmission lines has been generally very satisfactory. Though construction started several months later than expected, the plant and the transmission lines were commissioned on schedule, due to a shorter construction period of the plant (reduction of 7 months on average). The transmission network was completed during 1965 and

?
See para
5.01

1966, instead of by November 1964 as expected, but transmission to VALCO's smelter was commissioned in due time before first operation of the smelter.

6.02 The monetary inflation which has taken place in Ghana has made it necessary to readjust the figures of the actual and estimated costs of the project (excluding interest during construction). The forecast construction costs set up in Table III have been computed excluding the allowances which were made in the domestic currency component for escalation in the costs of labor, and the actual costs have been obtained by deflating the local expenditures incurred each year for the project by the Ghanaian cost-of-living index. The result suggests that the total cost of the project (including only one-fourth of the resettlement costs; para. 5.04) has been about \$18 million lower than estimated, savings originating mainly from the low bid received for the civil works contracts and from the transmission part of the project. The foreign exchange component of the plant was higher than estimated by about \$5 million, but its local cost component was reduced by about \$11 million equivalent. Substantial savings were made on transmission, on both local and foreign components. As a result, the unit capital cost of the plant has been \$209 per kw installed, and the unit cost for the whole scheme (plant and associated transmission) dropped from \$285 expected to \$253 actual.

VII. Development of the Institutions

7.01 The first Chief Executive of VRA was an engineer from the Ontario Hydroelectric Commission of Canada, assisted by an Indian

Financial Adviser and by a Chief Engineer and a Chief Accountant both appointed from Ontario Hydro. The remaining staff of the Authority were Ghanaians. In addition, 15 Ontario Hydro staff were attached, under a technical assistance contract, to VRA to initially operate the facilities and give on-site training. Complete operational responsibility was transferred in 1967 to the Ghanaians who had received good training and have satisfactorily operated the facilities since. The present Chief Executive, a Ghanaian previously Chief Engineer of the former Electricity Division, was appointed to his present position in 1966. Senior staff positions (except Director of Engineering) were filled with Ghanaians after contracts with foreign staff were not renewed by VRA because of the costs of these contracts. The Canadian Engineering Director left VRA in May 1971 and ~~will~~ ^{has been} probably be replaced by a Ghanaian. Senior staff is well-qualified, but the Authority has been short of qualified middle-level staff. The accounting department needed reorganization in order to improve its procedures and reduce unqualified staff. VRA agreed during the second loan negotiations to carry out a review of its operations, organization structure, accounting system and staffing policies. VRA engaged for this purpose the services of Ontario Hydro who submitted a report in early 1971; the consultant's recommendations are still being examined by VRA.

7.02 Similar weaknesses have existed in the accounting department of the Electricity Corporation of Ghana. Establishment of ECG, to which

the Government was committed under Loan 310 GH, was delayed because of political changes in Ghana and the time required to formulate the basic charter of the new corporation. The Government decree establishing the Corporation (ECG) was published in January 1967 and became effective in July 1967. The Chief Executive of VRA has been a member of its Board. ECG has received the assistance of engineering consultants (W. Lahmeyer of Germany) and of its auditors, Cooper Brothers (who are also VRA's auditors), for management consultancy and reorganization of its accounting system on a commercial basis. In 1968 ECG received an IDA credit of US\$ 10 million to cover the foreign exchange cost of a distribution expansion project; the distribution facilities were essential to meet power demands and to allow maximum use of VRA's energy to replace expensive diesel generation. *A second IDA credit of US\$ 7.1 million was made in 1971.* Because it was essential that distribution facilities in Ghana should keep pace with the development of generating facilities and because the bulk of ECG sales would come from its purchases of power from VRA, *credits were* the loan to ECG was a logical sequence to the Volta project and has *are* been expected to add materially to the profitability of VRA.

7.03 The Bank has continuously favored merger of the operations of VRA and ECG. Earlier proposals to merge the former Electricity Division with VRA did not materialize, mainly for political reasons, and ECG was established as a separate entity. Because of the heavy dependence of ECG on VRA power and of some possibilities of staff economies, consolidation of the two entities has continued to be considered. Recent efforts,

however, have been hampered by the existence of the non-power activities undertaken by VRA under its status of regional development agency. In addition to resettlement and lake research, VRA started in 1967 to operate a pilot transportation system on the Volta Lake with income losses in 1968 and 1969. The termination of this scheme in March 1970 by establishing, with Danish assistance, the Volta Lake Transport Company as a separate entity has been a first step toward making a merger of the two organizations possible.

VIII. Conclusion

8.01 The risks envisaged by the Bank when helping to establish VRA did not materialize significantly. All obligations undertaken by Ghana have been fulfilled and agreements respected. The VRA has been operating satisfactorily on the whole and VALCO and ECG have been well serviced. Except for some organizational and overstaffing problems caused by social and environmental responsibilities of VRA and from governmental pressures, and which are under study for future improvements, the management of VRA appears to have performed better than expected. Technical performance has been satisfactory, with small distribution losses and capacity out of service kept to a reasonable level. Financial indicators suggest an improving situation, though still fragile.

8.02 Mainly because of lower capital costs than expected, and partly because of higher sales than expected, VRA has ~~apparently~~ been able to earn slightly more than the expected rates of return despite

charging much less than originally envisaged for non-aluminum consumption. However, these returns ^{may be} are somewhat overestimated because most of the resettlement expenditures are omitted from capital costs; ~~more-~~ ~~over, strict comparison with other utilities would require full revaluation of book values of capital expenditures to allow for interim inflation.~~ There are also some negative environmental effects, but presently of very unclear dimensions.

8.03 VRA and the Government are now aiming at earning an 8% rate of return on VRA's net fixed assets, as recommended by the Bank for ECG. After the Bank expressed its concern in 1968 about the low tariffs charged by VRA to ECG and recommended a review of VRA's tariff structure, VRA engaged consultants, Preece Cardew and Rider, to review the original power cost allocation studies previously undertaken by KECI and VRA and to make recommendations. A preliminary report in 1969 indicated that any tariff adjustment would be either small or not necessary. The final report, issued in 1970 and based on the 8% return assumption, has recommended, according to VRA's management, tariff increases similar to those computed by VRA itself; in particular, it is suggested that the VALCO tariff could rise from 2.625 mills/kwh to more than 3 mills/kwh, though this would imply the renegotiation of the 30-year power contract. Tariff increases are still under VRA and Government consideration.

What about
the tariff
changes ECG?
Since ECG
may pay
50% of the
tariff recommended
by the Bank
shouldn't
ECG's tariff
be adjusted
before attempting to
renegotiate a new
contract with VALCO?

8.04 The completed power plant at Akosombo is expected to meet

market requirements until 1977. To meet increased demand from VALCO for a possible fifth pot-line and also the increased demand from the normal growth of ECG and other consumers, VRA has been investigating various potential hydro developments in Ghana and is considering other possibilities -- such as importing power from Nigeria through Togo and Dahomey (~~possibly the most economical solution~~) or the installation of thermal capacity. ~~Ghana does not have any known indigenous fuel resources, but a thermal solution would avoid the environmental problems which may be characteristic of dams in West Africa.~~ VRA is also planning the extension of its transmission network.

8.05 Prospects for the power sector are good. Net foreign exchange earnings from the combined hydroelectric/aluminum project (including savings made by meeting non-smelter demand from Akosombo rather than from a thermal plant) have ~~probably~~ been positive, and will increase when Ghana's own bauxite deposits are exploited. The availability of a large source of cheap power has allowed ECG to decrease its tariffs, in particular the tariffs for industrial consumption which has developed rapidly after 1966 with the establishment of small industries in Tema. Through payment of ~~direct taxes (to be levied on VRA and ECG starting in 1971)~~ and dividends in the coming years to the Government, the sector will contribute to an increasing extent to the Government's general development expenditures; this would be justified because of the Government's relatively heavy investment in the power sector which presently directly benefits

only about 16% of the population.

8.06 The scope of this study has been confined to evaluating achievement of the direct objectives of the Bank's loan for the Volta hydroelectric project. The VRA case raises important economic, social and ecological issues which deserve further investigation. ~~In connection with its financing of such a large source of cheap power the Bank might have done more to promote local industrial development.~~ The actual and potential multipurpose aspects of the project -- transport, fishing and irrigation -- would have warranted more consideration. The institutional, administrative and financial measures required to prevent or to remedy negative social and environmental effects of the project would seem to have merited much more attention from the Bank, as integral parts of the project -- especially in view of the great delays and unsatisfactory conditions which have actually beset the resettlement program. ~~Partly because of the large social costs involved it remains an open question whether the project's net benefits to Ghana have been positive or whether it has benefitted more the Kaiser Corporation.~~ This should be studied.