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INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT  
INTERNATIONAL DEVELOPMENT ASSOCIATION

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(in four volumes)

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(in seven parts)

PART SIX: ANNEX E - ELECTRIC POWER

August 31, 1967

Africa Department

## EQUIVALENTS

### Currency

1 Uganda Shilling	=	U. S. \$0.14
U. S. \$1	=	U. Sh 7.14
£ 1	=	U. S. \$2.80
£ 1	=	U. Sh 20.00

### Weight

Throughout this report, unless otherwise stated, tons refers to long tons of 2240 lbs.

### COMPOSITION OF THE MISSION

This report is based on the findings of a Mission to East Africa which did its field work in October, November and December 1966 and consisted of the following:

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The Mission's findings relate for the most part to the situation as of the end of 1966, although in some respects note has been taken of developments up to the middle of 1967.



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## ELECTRIC POWER IN UGANDA

### SUMMARY AND CONCLUSIONS

1. Sales of energy in Uganda are expected to increase at an average rate of between  $6\frac{1}{2}$  percent and  $7\frac{1}{2}$  percent per annum over the period 1966 through 1975.
2. Allowing for uprating of the completed Owen Falls Station from 150 MW to 180 MW and also for an increase in the water available from a mean flow of 505 cubic meters per second (cumecs) to 630 cumecs, the Owen Falls Station will be fully committed and a new source of power will be required by about 1972 or 1973.
3. A decision on where to obtain additional energy will need to be made by early 1968 at the latest, in order to allow an adequate time interval for financing and construction of the next major development.
4. In order to explore the advantages of cooperation with Kenya in the provision of additional generating capacity in 1972 or 1973, an immediate attempt should be made to start discussions with the Kenya Government and power companies as recommended by the Uganda Electricity Board at their meeting of November 25, 1966.
5. Some consideration should be given to a review of tariffs having regard to the need to obtain optimum usage of the available facilities.



## ELECTRIC POWER IN UGANDA

### Introduction

1. Public supplies of electricity throughout the whole of Uganda are provided by The Uganda Electricity Board (UEB). Prior to 1948, public supplies of electricity in Uganda were provided by the East African Power and Lighting Company Limited (EAP&L) and were limited to the Jinja, Entebbe and Kampala areas. Toward the end of World War II, the EAP&L, anticipating a rapid expansion of demand in the post-war period, obtained from their consultants a feasibility report on a proposed hydroelectric project on the Nile at Bujugali costing about £2 million with an initial installation of about 20 MW. Application was made to the Uganda Government for a generating license with a view to constructing the project. The Government of Uganda, having at that time accumulated considerable reserves through the Marketing Boards created during and after the war, decided instead to take over the EAP&L's assets on the terms and conditions laid down in the Company's licenses. For this purpose The Uganda Electricity Board was established in 1948, and generous compensation was paid to the Company for acquisition of its assets.

2. The decision to take over the EAP&L's assets was influenced by the report of Mr. Charles Westlake who had been commissioned by the Uganda Government to report upon the development plans of the Company and the future of electricity supplies in Uganda. The Westlake report, which was completed in 1947, contained very optimistic forecasts of demand, dismissed the Company's Bujugali project as inadequate, and recommended the taking over of the Company's assets and construction of a much larger project about three miles further upstream at Owen Falls. The Government adopted the report's proposals and appointed Mr. Westlake as the UEB's first Chairman.

3. The initial Owen Falls installation was commissioned in January 1954 at which time the load on the system was 15 MW. By this time the optimistic nature of the demand estimates contained in the Westlake report could no longer be ignored, and the UEB commenced negotiations with the EAP&L for a bulk supply of 45 MW to Kenya on terms which were not very attractive to either of the contracting parties, but in the particular circumstances existing at that time, happened to suit them. The EAP&L was faced with the prospect of increasing its expensive diesel generation in Nairobi or raising a large amount of capital for a major hydroelectric project at Seven Forks. The cost of the bulk supply when delivered to Nairobi though 60 percent more than the Company's own hydro power was still cheaper than diesel generated power, and was a convenient means of filling the gap until the Company was ready to construct Seven Forks. On the other hand the UEB in 1956 with a capital investment of about £22 million had a gross revenue of only £1.1 million and was losing nearly £1 million a year, most of which was being capitalized.

4. On completion of negotiations, the 300 miles of double-circuit 132-kv line crossing a 9,000-foot mountain range, from Owen Falls to Nairobi was built in the very short time of eighteen months. The bulk supply to Nairobi was inaugurated on January 1, 1958.

5. Only since the beginning of 1965 with a maximum demand of 100 Mw (40 of which was for the Kenya Bulk Supply) and sales of 523 million kwh (of which 191 million were to Kenya), has the UEB been able to show a surplus.

6. There is no other licensed public supplier of electricity in Uganda but the UEB has issued 46 private generating licenses totaling 1100 kw of plant, to individuals, firms and Government administrative centers beyond the reach of the UEB mains.

#### Demand for Electricity

7. The growth of demand from 1949 to 1966 is shown in Table 1 together with the annual load factors and the annual percentage increases. A considerable proportion of the increase in demand in Uganda over the past ten years has been due to the expansion of the transmission and distribution systems into new areas. For example, the total length of lines in service has increased from 629 miles in 1954 to 4,475 in 1966, and much of this development can be classified as rural development. With the exception of the copper smelter, steel rolling mill, and textile factory at Jinja, none of the major loads forecast in the Westlake report materialized. Nevertheless, over the years, there has been a considerable development of minor industrial load, mainly in the Jinja and Kampala areas. Sales of energy by categories over the years 1949 to 1966 are shown in Table 2.

8. The average annual increase of power demand for minor industries on standard tariffs between 1956 and 1966 was about 10 percent. In the same period total industrial power demand including major industries on special tariffs increased at an average annual rate of a little over 23 percent.

9. Residential demand over the period 1954-1959 increased at an average annual rate of about 13 percent, but since then it has stagnated mainly due to the uncertainties attendant on the transition to independence. However, in 1965 and 1966 there have been increases of 12 and 11.2 percent.

10. Sales to commercial consumers including hotels and clubs have increased at a fairly steady average annual rate of about 13 percent over the ten-year period 1956-1966.

11. The export to Kenya has remained steady at around 190 million kwh per annum since 1961 until 1966 when it rose to 203 million kwh.

#### Existing Installations

12. The capacity of hydroelectric generating plants installed at Owen Falls is now 135 MW consisting of nine machines of 15 MW each. It has been found that both the turbines and alternators of these machines are capable of sustained operation at 18 MW, and the UEB is now contemplating the uprating of the existing machines to raise the station capacity to 162 MW. The foundations are completed for a tenth machine identical to the existing machines which would complete the station. This machine was ordered in 1966 and is due to be commissioned in June 1968. The power station is installed in the base of the dam and operates on a head of about 60 feet utilizing Kaplan turbines.

13. The mean level of Lake Victoria is about 3,716 feet above sea level, and varied between 3,713.5 and 3,719.2 in the period 1899 to 1961. Although the Owen Falls Dam, which is situated on the Nile at Jinja just below the outlet from the Lake, was designed to artificially raise the level of the Lake to 3,723.5 feet, if required to provide additional storage for downstream

users, and Egypt contributed to the increased cost of the dam on this account, it has in fact never been used for this purpose. This is because no agreement has yet been reached on the question of compensation to owners of lakeside land, whose properties would be flooded. However, exceptionally high flows in the rivers feeding the Lake in the period 1962 to 1966 have raised the level of the Lake to 3,724 feet. The UEB maintains that this rise has not been influenced in any way by the construction of the dam since they have been operating the sluices in the dam in such a way as to allow the level of the Lake to follow its natural regime. In this respect they have been complying with the provisions of the 1929 Nile Waters Agreement except for a short period in 1965 when high discharges were continuously maintained to artificially lower the Lake level because of the threat to lakeside installations and the Owen Falls Dam itself.

14. The Lake, with an area of 26,100 square miles, is one of the largest natural reservoirs in the world, and has a catchment area of 103,200 square miles containing mountain ranges up to 15,000 feet high. With such a vast long-term storage basin it would be unreasonable to relate power output to run-of-river conditions. For this reason a tentative agreement with other interested parties was reached in 1948, which provided for a firm average discharge for power purposes at Owen Falls Dam of 505 cubic meters per second (cumecs). The balance between this average discharge of 505 cumecs and the then estimated average flow of 676 cumecs (based on flow readings since 1899) would be stored in the Lake and released according to the requirements of downstream users. This agreement has however never been confirmed or adopted.

15. The recent high discharges from the Lake have raised the mean flow from 1899 to 1965 from 676 cumecs to 746 cumecs and the UEB's consultants maintain that an allocation of 630 cumecs would be more appropriate as a mean flow on which to base outputs for generating stations in the stretch of the Nile between Lake Victoria and Lake Kioga, some 75 miles downstream. A flow of 630 cumecs passing through the Owen Falls Station would generate about 900 million kwh per annum instead of the 720 million kwh originally assumed. In fact, due to the present very high level of the Lake, it is probable that if the discharge is limited in future to the needs of power production at Owen Falls Dam, an annual output of well over 900 million kwh could be maintained for some years after the demand for energy reaches this figure. Daily or weekly fluctuations in discharge due to the fluctuating power demand do not present a problem to downstream users since there are two very large natural afterbay reservoirs in Lake Kioga and Lake Albert, (both in Uganda), which smooth out variations of this kind.

16. In order to justify the incorporation of additional plant in the design of the proposed Bujugali Station, the UEB recently attempted to obtain an increase from 505 cumecs to 630 cumecs in the amount of water discharge tentatively allocated to power production in the 1948 agreement. The matter was referred to an international committee of water commissioners from the countries concerned, i.e., Uganda, Kenya, Tanzania, Sudan and Egypt, but it is understood that this committee has recommended an increase to 550 cumecs only. However, the Government of Uganda is pressing for an increase to 630 cumecs and since the 1948 agreement has never been confirmed and the quantity of water passing the Owen Falls Dam is greatly in excess of this amount and, moreover, there is no other outlet to the Lake, the level of which is now being maintained in accordance with its natural regime under the 1929 Nile Waters Agreement, the question is to some extent an academic one.

17. In addition to Owen Falls the UEB has five thermal stations. The largest contains 10 diesel driven generators of 800 kw each, installed between 1950 and 1952 at Jinja during the construction period of Owen Falls Power Station. The other four are isolated diesel driven power stations at Kikagati (1,750 kw), Kabale (550 kw), Arua (500 kw) and Moroto (500 kw).

#### Organization

18. The UEB was established under the Uganda Electricity Board Ordinance 1947, later amended in 1961 with assistance from the International Bank for Reconstruction and Development. The Ordinance gives the UEB in perpetuity all the normal powers included in a license and in addition authorizes the UEB to issue generating licenses to other users who are either able to generate at lower cost than the UEB can supply them (as for example where process steam is required), or who are so far from the nearest UEB mains that the cost of the necessary extension would be prohibitive.

19. The UEB is an autonomous corporation established by the Government for the purpose of providing electricity supplies throughout the country on a commercial basis. The Board consists of a full-time Chairman and not less than five, nor more than eight members, all of whom are appointed by the Minister of Commerce and Industry. At the present time the Deputy Chairman is also a full-time member of the Board who was for many years the UEB's Chief Accountant. Other members are part time only.

20. The Board has enjoyed a high degree of real autonomy since its establishment. It has of course been careful to ensure that its policies are generally in line with the Government's policies, but only insofar as these do not conflict with the principle that it should be guided by normal commercial practices in the performance of its functions. Although the Minister has powers under the Ordinance to direct the UEB in matters of public interest, he has never yet used them, nor has the Government at any time put pressure on the UEB to carry out sub-economic developments in rural areas. Although the Government would like to see lower tariffs in force in the rural areas it has refrained from using its powers to bring this about.

21. The permanent employees of the UEB number about 1,350 of whom about twenty are expatriates on contract employment and 96 are of Asiatic origin. Most of those of Asiatic origin were born in Uganda and are Uganda nationals. It is expected that all but about three or four of the senior expatriates will be replaced by Uganda nationals within the next two years. The total number of persons now employed, though small in relation to the size of the undertaking and the numbers employed in the past, is adequate. In fact, the reduction in numbers has increased the efficiency of the organization in recent years. Some of this reduction has been made possible by the introduction of electronic data processing machines in the accounts department.

22. The Board has a small training school at Jinja and sends students to local colleges and universities, as well as overseas for special training.

23. The Board determines the staff salary scales and terms of service. In practice the general level of salaries for senior staff is comparable with salaries of Government officials and considerably higher than average commercial

salaries. In the lower grades the UEB pays appreciably more than either Government or industry. The Board experiences little difficulty in obtaining and retaining staff of the quality, and in the numbers, required.

24. The Board employs consulting engineers on all major generation and transmission projects and also pays for permanent representatives of the consultants to be available in the UEB office at all times, to give advice on day-to-day engineering problems.

25. The Board's construction department is capable of building transmission lines up to 132 kv and at present is carrying out all new works, involving an expenditure of about E1 million a year. In the past when the volume of work has exceeded the department's capabilities, contracting firms have been employed on major items in the program.

#### Finances

26. Summaries of the UEB balance sheets and revenue accounts from 1954 to 1965 are given in Tables 3 and 4 respectively. It will be noticed that the amount of equity is insignificant. The preponderance of loan capital presents serious financial problems with regard to its redemption, and the Government and UEB are now faced with the need to redeem a foreign loan of E9.1 million in 1969 and another of E4 million in 1973, in addition to providing the capital for expansion of the undertaking to meet the growing demand. Mainly because of lack of revenue, sinking fund provisions in the past have been inadequate, and in 1969 only E2.7 million will be available leaving a balance of E6.4 million to be found. The Board has promised to pay the Government E2.5 million from revenue over the three years 1967 through 1969, but this still leaves E3.9 million to be refinanced. With the Bank's consent the UEB has recently obtained a E4 million loan from Exporters Refinance Corporation (ERC), half of which will be used to redeem some of the 1969 debentures. The remainder will be used for general development, releasing equivalent funds from revenue to redeem the balance of debentures due in 1969. This loan will be repayable over the 7-year period 1967-1973 and in effect relieves the Government of the necessity of lending E4 million to the UEB in 1969 for redemption of the 1969 debentures. A similar problem exists with regard to redemption of the E4 million in 1973 toward repayment of which the sinking fund will have provided only E1.3 million. It is not possible to forecast how the Government will deal with this question, but a possible solution may be for the UEB to increase tariffs.

27. Most of the financial difficulties now being experienced by the UEB are the result of past errors. Over-optimistic estimates of future demand, unnecessarily large initial installations and lavish design of Owen Falls Power Station as well as over-extended mains have all contributed to the high cost of power, and failure to face up to the realities of the situation and raise tariffs instead of capitalizing losses and expenditures properly attributable to revenue account have added to the difficulties of the present management, to whom credit is due for the very marked improvement in recent years.

28. The policy of the present management is to finance as much capital development as possible out of revenue even to the extent of 100 percent of all development other than major generating projects. In the same vein, the possibility of deferring expenditure on future major generating projects in Uganda by cooperation with Kenya is being actively pursued. Thus the Board, at its meeting on November 25, 1966, passed a resolution urging that the possibilities of such cooperation with Kenya be studied by a committee of interested parties under a Chairman to be nominated by the World Bank.

## Tariffs

29. In general the standard tariffs of Uganda are higher than those of Kenya or Tanzania, but the relatively low rates charged for the high load factor demands of the seven large consumers on special tariffs and the bulk supply to Kenya (which together account for 50 percent of units sold) bring the overall average yield per kwh sold to a much lower figure than either of the other two East African countries.

30. In systems based on thermal generation an improvement in system load factor will result in economies in production for any generating station already built. This is not true, however, for systems based on hydroelectric generation requiring major storage dams. In such systems the cost of production is almost entirely fixed by the cost of providing the storage. It follows therefore that whereas in thermal based systems the tariff structure should contain inducements to operate at a high load factor, this may not be desirable in systems based on hydroelectric storage, once the project has been constructed. In fact such inducements can lead to undesirable consequences, particularly as in the case of Uganda where the whole system at present contains only one generating station. For example, the Owen Falls Station is designed and equipped to operate at 60 percent load factor, and is limited by the availability of water to an annual output of about 900 million kwh. For reasons given elsewhere in this report, the UEB has entered into agreements to sell large blocks of power on tariffs which contain powerful incentives to operate at very high load factors with the result that the system load factor for several years has been well over 60 percent. Since the station is already built, and the costs of production are therefore fixed, these inducements merely result in a reduction in the total revenue which can be obtained from the limited output of about 900 million kwh, with no corresponding reduction in costs. As a result the UEB in order to make ends meet has been obliged to raise the level of rates on standard tariffs to make up the deficiency. The present management of the UEB is now trying to rectify this unsatisfactory state of affairs by raising the level of special tariffs to large consumers, as opportunity arises through the expiry of existing agreements. However, since the Kenya Bulk Supply tariff (which contains no rate revision clause) has another 40 years to run and being a simple kilowatt demand tariff encourages the Kenya companies to operate it at near 100 percent load factor, it would now be necessary to positively discourage a system load factor approaching 60 percent in Uganda in order to obtain the optimum economic use of the Owen Falls Station. To achieve such a result it would seem that future changes in tariff structure should be in the direction of flatter and higher power tariffs and lower residential and commercial rates, unless it is possible to eliminate the bulk supply agreement in the course of a much wider agreement with Kenya on cooperation in the development of generating resources.

31. Since 1950, the standard tariff has been increased 25 percent in September 1953, decreased 5 percent in January 1955, once again increased in April 1959 by 13.4 percent and then again in July 1961, by 18 percent. Total net cumulative increase thus amounted to 58.8 percent.

32. Of the seven large power consumers now on special tariffs some are

yielding a return of less than 6 cents per kwh sold <sup>1/</sup>, but the new tariffs now being negotiated are designed to yield a minimum of 6 cents per kwh sold.

33. Much criticism has been directed at the bulk supply agreement with Kenya and it is true that the rate of £13.5s (US\$37.10) per kw of demand at which this power is sold to Kenya is too low in relation to the cost of production in Uganda. On the other hand, the cost per kwh delivered in Nairobi, including transmission and losses is 60 percent higher than the cost of locally generated hydro power. The UEB would now like to revise the tariff but the agreement contains no rate revision clause. Some minor changes were negotiated in 1963 which were to the benefit of both parties, and particularly to the UEB which obtained a reduction in load factor and in the amount of power to be provided after 1967. As the agreement now stands the UEB is committed to supplying the Kenya company's requirements up to an amount of 45 MW until the commissioning date of the first 20 MW machine at Seven Forks, which is expected to be in early 1968. Thereafter Uganda is only committed to supply 30 MW to the Kenya company at the Tororo sub-station on the borders of Uganda until the year 2007. The revised agreement also provides that if Uganda has spare capacity available, Kenya may buy spill units over and above the 30 MW bulk supply. The UEB gained a slight increase in the yield on the bulk supply from the supply of these spill units which are now being billed at 9 cents per kwh. Unless this agreement is cancelled by mutual agreement during the course of a general agreement between the two countries to cooperate in future development of generating resources, there is little prospect of the UEB obtaining any further improvement in the conditions.

#### Future Demand

34. Estimates of future energy requirements for the years 1967-75 are shown in Table 5. These may be divided into three sections: sales on standard tariffs; sales on special agreements, and bulk supply to Kenya. The estimate of sales on standard tariffs and for the bulk supply are in accordance with the UEB's own estimates. In the case of sales on special agreements, the UEB estimates have been modified in the light of discussions with the UEB management, the consumers themselves and other information obtained by the Mission.

35. The annual increase forecast for sales on standard tariffs over the period 1967 to 1975 falls from 18.5 percent in 1967 to 7.8 percent in 1975 and averages about 10.5 percent over the whole period. The average over the preceding 10 years was a little over 10 percent, but would have been much higher but for the uncertainties attendant on the transition to independence which resulted in an actual drop in sales on the residential tariff in 1961 and 1962. Sales on this tariff did not recover until 1965 when a 12 percent increase over the previous year brought them above the previous record of 1960. Sales on the small industry and commercial tariffs were also affected by the exodus of expatriates but only to the extent of causing a temporary reduction in the annual rate of increase. The estimates of sales on all these standard tariffs are

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<sup>1/</sup> In this report, Tanzanian cents are used. There are 7.14 Tanzanian cents to the US cent.

reasonable and might well be exceeded. A list of small- to medium-sized industrial projects known to be in hand or under consideration is given in Table 6.

36. Estimated sales to Kenya are based on the amendments to the Bulk Supply Agreement negotiated in 1963 (see paragraph 33). Spill units have not been included in the estimates as the quantity is small and is difficult to predict. The 200 million kwh per annum included in the total units sold represent a steady offtake of 31 MW at a load factor of 73.7 percent.

37. Estimated sales on special agreements for the period 1967 to 1975 are given in Table 7. There is some difficulty in forecasting these sales from 1969 onwards as the proposals for expansion of the textile and steel industries have not been fully developed.

38. The Nyanza Textiles agreement with UEB expired in January last year, since when they have been charged a flat rate of 6 cents per kwh pending agreement on a new tariff which UEB estimated will yield a minimum return of 6 cents per kwh. The yield of 6 cents per kwh represents an increase of 36 percent in electricity charges to the consumer who is now considering the economics of changing over from the existing electrode boilers to oil fired boilers for process steam raising. Alternatively, he may only utilize oil fired boilers for the extension contemplated in 1970. The effect of both the alternatives is shown in Table 7.

39. In the case of the steel industry the existing rolling mill has a furnace for melting scrap iron but supplies are proving inadequate and the market for the mill's products is expanding. The mill owners are contemplating the addition of a small furnace with a load of about 10 MW which would produce what they refer to as "artificial scrap" from the iron ore available at Tororo. The project would cost about £500,000 and the Government is not contemplating participation in this venture because it has in mind a much larger project for development of the Tororo iron ore deposits at a later date. No finance for the smaller project has yet been obtained nor has the process to be used been finally determined, though this is said to present no problem. There is therefore some doubt as to whether this load will materialize, but it has been assumed in the estimates that it will be commissioned in 1968.

40. The effect on total sales would be much the same if either Nyanza Textiles changes over to oil for steam raising, or if the steel furnace does not come on. In Table 5 the total sales shown in the column headed "with textile steam load" assumes that neither of these eventualities will occur. The second column headed "without textile steam load" shows the effect of either one or the other occurring.

41. A proposal to construct a fertilizer factory which would have an electrical demand on the UEB of 60 MW has not been included in the estimates. The promoters of the project originally stated that a price in excess of 2 cents per kwh would be unacceptable but later increased this to 3 cents. Such a low rate could not be offered by the UEB without incurring very heavy losses and this has been accepted by the Government who have consequently considered subsidizing the rate. Foreign finance may be available for the project, but the Mission doubts whether such a project would be justified in

Uganda, particularly since a more attractive fertilizer project is already in an advanced stage of negotiation for Mombasa in Kenya. The natural advantages of the Mombasa site are such that it is unlikely that the Uganda project could compete other than in the relatively restricted market of Uganda. This load has therefore not been included in the estimates.

42. The maximum demands estimated to correspond with the estimated energy sales given in Table 5 are shown in Table 8.

#### Capital Program

43. The main details of the capital program of the UEB for the years 1966 through 1975 are shown in Table 9. The latest available actual expenditure (1965) has been shown for purposes of comparison.

44. The present nominal capacity of the nine machines in Owen Falls totals 135 MW, but the known capability is 162 MW and the UEB is considering uprating the nominal capacity to this figure. A tenth machine is already scheduled for commissioning in 1968 which will raise the total uprated capability to 180 MW and the firm capability to 162 MW. Reference to Table 8 shows that no additional capacity is then required to meet the maximum demand before the end of 1973 and possibly not before the end of 1975. However, reference to Table 5 shows that additional capacity may be required to meet the energy requirements by the end of 1972, unless the Lake can be maintained at a high enough level in the intervening years to provide the additional kwh required up to 1975.

45. Assuming it will take approximately four years from the date of placing contracts to the commissioning of any major hydroelectric project such as Bujugali on the Nile, it would seem that a decision on the next major development will be required at the end of this year or early in 1968. This would allow one year for appraisal and negotiations on finance before placing contracts at the end of 1968 or early in 1969.

46. In its desire to avoid incurring any further capital expenditure earlier than is absolutely necessary, the UEB has resolved to utilize the period up to the end of the current year in an endeavor to cooperate with Kenya over further exchanges of power and the joint development of future generating resources. They consider the simplest way of achieving this would be the creation of a joint authority for all major generation and transmission in the two countries which would involve the taking over of the existing major hydroelectric stations in Kenya and Uganda and also the 132-kv bulk supply transmission lines and sub-stations. Such a step would require no initial cash outlay other than the acquisition of the nominal nongovernment shareholding of the Kenya Power Company and The Tana River Development Company, amounting in all to £142. Both these companies are financed entirely by debentures and are required by their articles of association and licenses to sell power at ascertained cost.

47. It is probable that cooperation in the form suggested by the UEB, or even in some looser form, would be of material economic advantage to both countries. It would with relatively minor expenditure enable the existing bulk supply lines to be put into reverse thus permitting the optimum use of thermal and hydro plant in both countries, and by pooling the standby requirement would increase the firm capability of the two systems, thus deferring further capital

expenditure on generating facilities for some time. By virtually doubling the annual increment of demand it would accelerate the loading up of the next major generation project thereby improving its cost/benefit ratio and reducing the cost per kwh generated, in the early years after commissioning. It would also justify enlargement of the list of future projects under consideration for development in the early 1970's to include some attractive proposals, both on the Tana River in Kenya, and the Nile in Uganda, which have hitherto been excluded on account of their size.

48. In the absence of any indication as to whether cooperation with Kenya can be achieved, expenditure on Bujugali has been shown in the program as commencing in 1969. This represents the worst case from a point of view of capital expenditure. If cooperation with Kenya is achieved and the next project selected for development is one of the later stages of Seven Forks, it is probable that Uganda's share of the expenditure would be less than a half of that shown in Table 9 for Bujugali. Moreover, part of the £1.5 million required for 132-kv lines in the Kampala/Tororo areas would probably not be required if a bulk supply is obtained from Kenya.

49. Expenditure on H.T. and L.T. distribution covers minor extensions at voltages of 11 kv and under, to small communities and individual consumers within a short distance of the extensive network of H.V. distribution lines which have been laid in recent years. There are no major projects envisaged for the electrification of remote communities which could be classified as sub-economic rural electrification schemes.

50. Table 10 shows the estimated sources and application of funds required to carry out the program outlined in Table 9. It will be noted that the UEB is moving into a new phase in which it is expected that gross income from the operating account will greatly exceed the interest on loans chargeable to revenue. This is fortunate in view of the need now to face up to the inadequacy of sinking fund payments in the past. Repayment out of revenue of the two loans totaling £13.1 million, mentioned in paragraph 26, will make a marked improvement in the balance sheet.

#### Future Strategy

51. There are no known deposits of fossil fuels in Uganda and the cost of importing fuel 700 miles by rail over the 9,000-foot Mau mountain range from the coast in Kenya makes thermal generation very expensive. Fortunately Uganda has great hydroelectric resources most of which are on the Nile which falls 1,700 feet from Lake Victoria before crossing the frontier into the Sudan. Most of this fall is between Karuma and Murchison Falls, about 200 miles and 250 miles respectively, downstream of Lake Victoria. Almost all the 1,700-foot head could be developed for power purposes, with a total potential of the order of 4,500 MW. Those schemes which have already been the subject of preliminary or detailed investigation are shown on the map attached.

52. As mentioned in paragraph 14, it is probable that the quantity of water passing the Owen Falls dam for the foreseeable future is likely to be in excess of that required to generate 900 million kwh per annum. Although the design of the Owen Falls Station was based on a flow of only 503 cumecs, that is to say, an annual output of only 720 million kwh per annum, it would be economic

folly to embark on the construction of another major generating project until there is reason to believe that the actual quantity of water passing the dam about five years ahead will be inadequate to meet the energy demand; or alternatively the installed capacity will be inadequate to meet the maximum demand. As mentioned in paragraph 13, the very high river flows in recent years, which have raised the level of Lake Victoria to unprecedented heights seem to indicate that the UEB can expect to obtain at least 900 million kwh per annum from Owen Falls for a period of some years to come and this should suffice to meet the maximum demand until 1972 or 1973.

53. As stated in paragraph 45, the UEB has until early 1968 to decide on whether or not to proceed with the construction of the Bujugali project. It is therefore of the greatest importance to settle the question of cooperation as quickly as possible. If a decision to proceed with Bujugali is taken in early 1968, cooperation with Kenya would imply the building of a second transmission line to Kenya at the same time, which would probably more than offset any benefits to both countries. It is probably true to say therefore that if agreement on cooperation is not reached in the next 12 months the opportunity will be lost, and may not arise again for a long time - possibly 20 years or more. On the other hand, Kenya is already constructing the first stage of its 250 MW Seven Forks project. If cooperation is achieved and the bulk supply line put into reverse, Uganda could obtain an additional 70 MW at a cost of finding only one-half of the capital required for the next stage of Seven Forks. Before reaching agreement on a cooperative program of power development, the proposed committee on cooperation will presumably wish to engage consultants to carry out a feasibility study of the benefits each country would obtain from cooperation. Such a study would require some time because the advantages of a number of alternatives would have to be explored. A decision is therefore urgently required.



Table 1: UGANDA ELECTRICITY BOARD: GROWTH OF MAXIMUM DEMAND, SALES & LOAD FACTOR, 1953-65

YEAR	Maximum Demand in MW.			KWH Sold in millions			Total KWH Generated millions	Increase over previous year %	Load Factor
	Uganda	Bulk Supply to Kenya	Total	Uganda	Bulk Supply to Kenya	Total			
1953	13.0	-	13.0	51.1	-	51.1	59.5		52.2
1954	15.0	-	15.0	63.6	-	63.6	73.2	23.0	55.7
1955	15.6	-	15.6	69.2	-	69.2	80.0	9.4	58.5
1956	21.6	-	21.6	82.3	-	82.3	95.0	18.7	50.3
1957	29.8	-	29.8	133.5	-	133.5	149.0	56.8	57.1
1958	36.3	15.0	51.8	162.7	90.0	252.7	278.0	86.6	61.3
1959	41.3	20.3	57.8	185.4	129.4	314.8	346.0	24.4	68.4
1960	45.0	23.9	62.8	202.4	160.0	362.4	397.0	14.7	72.2
1961	46.6	26.0	73.6	209.2	191.3	400.5	435.0	9.6	67.5
1962	52.0	26.0	73.4	228.2	189.0	417.2	453.0	4.2	70.5
1963	54.8	36.0	85.3	270.6	190.0	460.6	497.0	9.8	66.5
1964	59.2	42.0	99.1	293.2	177.6	470.8	521.0	4.8	60.0
1965	67.0	42.0	103.0	332.1	190.5	522.6	572.0	9.8	63.4
1966	?	42.0	113.9	357.7	203.0	560.7	635.0	11.0	63.6

NOTE: In the case of maximum demands, the Bulk Supply to Kenya and the Total Demand are recorded figures but with the exception of 1965 and 1966 and 1953 to 1957, the Uganda demand has been estimated from the units sold in Uganda.

Table 2: UGANDA ELECTRICITY BOARD: ACTUAL AND ESTIMATED SALES, 1953-66

(millions of kwh)

Year to 31 Dec.	DOMESTIC		COMMERCIAL		SMALL INDUSTRIAL		STREET LIGHTING		TOTAL UNDER STANDARD TARIFFS		SPECIAL TARIFFS (See Table XII)		TOTAL IN UGANDA		KENYA BULK SUPPLY		GRAND TOTAL		Year to 31 Dec.
	Annual kwh	% Increase	Annual kwh	% Increase	Annual kwh	% Increase	Annual kwh	% Increase	Annual kwh	% Increase	Annual kwh	% Increase	Annual kwh	% Increase	Annual kwh	% Increase	Annual kwh	% Increase	
1953	18.1	-	8.8	-	11.6	-	0.5	-	42.0	-	9.1	-	51.1	-	-	-	51.1	-	1953
1954	21.6	19.3	10.7	21.6	20.3	39.0	0.9	80.0	53.5	27.4	10.1	11.0	63.6	24.5	-	-	63.6	24.5	1954
1955	25.7	19.0	12.5	16.8	20.7	2.0	1.3	44.4	60.2	12.5	9.0	-	69.2	8.8	-	-	69.2	8.8	1955
1956	30.8	19.8	14.2	13.6	21.7	4.8	1.5	15.4	68.2	13.3	14.1	56.7	82.3	18.9	-	-	82.3	18.9	1956
1957	36.4	18.2	14.8	4.2	31.1	43.3	2.0	33.3	84.3	23.6	49.2	248.9	133.5	62.2	-	-	135.5	62.2	1957
1958	39.3	8.0	17.6	18.9	35.2	13.2	2.5	25.0	94.6	12.2	68.1	38.4	162.7	21.9	90.0	-	252.7	89.3	1958
1959	40.8	3.8	19.3	9.7	40.3	14.5	2.7	8.0	103.1	9.0	82.3	20.8	185.4	13.9	129.4	43.8	314.8	24.6	1959
1960	41.0	0.5	23.6	22.3	43.5	7.9	3.2	18.5	111.3	7.9	91.1	10.7	202.4	9.1	160.0	23.7	362.4	15.1	1960
1961	39.6	-	25.1	6.4	49.2	13.1	3.7	16.0	117.6	5.7	91.6	0.6	209.2	3.4	191.3	19.6	400.5	10.5	1961
1962	38.9	-	26.1	4.0	50.2	2.0	3.4	-	118.6	0.9	109.6	19.6	228.2	9.8	189.0	-	417.2	4.1	1962
1963	49.5	1.6	28.9	10.7	64.3	28.1	2.9	-	136.6	15.2	134.0	22.3	270.6	18.6	190.0	0.5	460.6	10.4	1963
1964	40.1	-	29.5	2.1	65.0	1.1	3.6	24.1	138.2	1.2	155.0	15.7	293.2	8.3	177.6	-	470.8	2.2	1964
1965	44.9	12.0	36.6	24.1	77.1	18.6	3.6	-	162.2	17.4	169.9	9.6	332.1	13.3	190.5	7.3	522.6	11.0	1965
1966	49.9	11.2	41.9	14.5	83.6	8.5	4.0	11.1	179.4	10.6	156.3	15.5	375.7	7.7	203.0	6.5	578.7	10.8	1966

Table 3: UGANDA ELECTRICITY BOARD: SUMMARY OF BALANCE SHEETS, 1954-66

(in £ thousands)

	1954 a/	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
<b>LIABILITIES</b>													
Uganda Government Loans	16,356	18,970	15,283	17,049	19,263	20,499	21,079	22,477	23,486	24,072	24,173	23,867	23,543
U. E. B. 5% Stock	-	-	6,000	6,000	6,000	6,000	6,000	6,000	5,989	5,989	5,989	5,989	5,989
Bonds & Short Term Loans	813	653	981	1,204	1,736	1,825	1,870	1,317	1,079	1,009	931	1,350	1,187
Accrued Interest	96	124	193	200	262	270	503	592	606	620	599	567	539
Total Loans & Interest	17,265	19,747	22,457	24,453	27,261	28,594	29,452	30,386	31,160	31,690	31,692	31,773	31,258
Reserve Funds	1,257	1,402	1,785	2,046	2,266	2,617	2,873	683	339	226	260	572	1,212
Sundry Creditors	707	581	610	753	594	394	251	242	303	441	482	617	626
Bank Overdraft	232	238	-	-	-	-	58	-	-	286	591	723	589
<b>TOTAL</b>	<b>19,461</b>	<b>21,968</b>	<b>24,852</b>	<b>27,252</b>	<b>30,121</b>	<b>31,605</b>	<b>32,634</b>	<b>31,311</b>	<b>31,802</b>	<b>33,643</b>	<b>33,025</b>	<b>33,685</b>	<b>33,685</b>
<b>ASSETS</b>													
<b>Fixed Assets, less Depreciation</b>													
Generation	11,943	13,530	14,611	15,581	15,406	15,958	16,447	15,751	15,484	15,225	14,999	15,528	15,196
Transmiss. & Distribution	3,130	4,259	5,388	6,741	8,422	9,363	9,965	9,076	9,755	10,759	11,356	11,579	11,572
Other	1,453	1,590	1,763	2,115	2,209	2,306	2,323	2,113	2,058	2,055	2,000	2,009	1,935
<b>TOTAL</b>	<b>16,526</b>	<b>19,379</b>	<b>21,762</b>	<b>24,437</b>	<b>26,037</b>	<b>27,627</b>	<b>28,735</b>	<b>26,940</b>	<b>27,297</b>	<b>28,039</b>	<b>28,355</b>	<b>28,846</b>	<b>28,703</b>
Investments	182	282	406	566	717	881	1,012	1,299	1,384	1,585	1,806	2,035	2,273
Stores	866	820	870	723	699	622	492	589	662	646	530	559	531
Sundry Debtors	304	198	314	224	333	302	342	386	483	555	595	568	617
Cash in Bank	577	136	215	36	133	32	-	125	91	20	29	53	26
<b>Deferred Expenditure</b>													
Acquisition Expenses	164	163	163	162	161	160	159	156	153	150	146	143	140
Loan Expenses	842	990	1,058	996	931	864	790	730	670	610	550	490	430
Development Expenditure	-	-	64	108	1,110	1,117	1,104	1,086	1,062	1,038	1,014	990	966
<b>TOTAL</b>	<b>19,461</b>	<b>21,968</b>	<b>24,852</b>	<b>27,252</b>	<b>30,121</b>	<b>31,605</b>	<b>32,634</b>	<b>31,311</b>	<b>31,802</b>	<b>33,643</b>	<b>33,025</b>	<b>33,685</b>	<b>33,685</b>

a/ Owen Falls Hydroelectric Station started generating power for sale on January 23, 1954

Table 4: UGANDA ELECTRICITY BOARD: SUMMARY OF REVENUE ACCOUNTS, 1954-66

	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
<u>REVENUE</u>													
Tariff Income	722	746	840	1,102	1,389	1,661	1,846	2,128	2,364	2,654	2,910	3,326	3,774
Rentals & Sundry Income	2	2	5	5	5	7	8	8	6	12	11	11	14
TOTAL REVENUE	724	748	845	1,107	1,394	1,668	1,854	2,136	2,370	2,666	2,921	3,337	3,788
<u>OPERATING EXPENSES</u>													
Operating Maintenance and Management	308	295	289	310	392	469	516	542	572	562	579	618	717
Depreciation	134	147	170	244	273	354	389	610	776	787	823	887	895
TOTAL EXPENSES	442	442	459	554	665	823	905	1,152	1,348	1,349	1,402	1,505	1,612
Total Revenue	724	748	845	1,107	1,394	1,668	1,854	2,136	2,370	2,666	2,921	3,337	3,774
Total Operating Expenditure	442	442	459	554	665	823	905	1,152	1,348	1,349	1,402	1,505	1,612
GROSS INCOME	282	306	386	553	729	845	949	984	1,022	1,317	1,519	1,832	2,162
Net Interest	519	582	837	990	1,101	1,137	1,263	1,338	1,399	1,435	1,465	1,475	1,460
Net interest charged to Capital	262	277	427	446	373	280	274	Nil	Nil	67	30	17	11
NET INTEREST CHARGED TO INCOME	257	305	410	544	728	857	989	1,338	1,367	1,368	1,435	1,458	1,449
Net Surplus (Deficit-)	25	1	-24	9	1	-12	-40	-354	-345	-51	84	374	713
Return on Net Fixed Assets %	1.7	1.6	1.8	2.3	2.8	3.1	3.3	3.7	3.7	4.7	5.36	6.3	7.5

Table 5: ESTIMATED KWH GENERATED, 1967-75

Year	Standard Tariff KWH sold in millions	Special Agreement KWH sold in millions		Total Uganda KWH sold in millions		Total KWH sold in millions with Kenya bulk supply		Total KWH Generated in millions	
		with textile steam	without textile steam	with textile steam	without textile steam	with textile steam	without textile steam	with textile steam load	without textile steam load
1967	212	199	199	411	411	611	611	669	669
1968	236	238	238	474	474	674	674	737	737
1969	262	276	276	538	538	738	738	807	807
1970	286	287	258	573	544	773	744	845	814
1971	313	297	232	610	545	810	745	885	815
1972	340	307	249	647	589	847	789	927	863
1973	370	307	249	677	619	877	819	959	895
1974	399	307	249	706	648	906	848	991	928
1975	430	307	249	737	679	937	879	1026	960

NOTE: KWH sold in bulk to Kenya has been assumed to be 200 million per annum because Uganda, under the Bulk Supply Agreement as amended in 1964 is obliged to supply only 30 MW to Kenya at Tororo from the date that Kenya commissions the first generator at Kindaruma Power Station in 1967 or early 1968. In fact, sales to Kenya will exceed 200 million KWH for several years during which Uganda has surplus power available, as additional sales of "spill units" are provided for under a supplementary agreement to the Bulk Supply Agreement, dated October 28, 1964.

**Table 6: LIST OF MEDIUM AND SMALL INDUSTRIES  
LIKELY TO BE CONNECTED, 1967-69**

INDUSTRY	LOCATION	Estimated Installed Load in Kw.		
		1967	1968	1969
Pelican Fish Factory	Lake George/Edward Area		50	
Uganda Fresh Fish	" " " "		40	
Water Pumping	" " " "		10	
TUFMAC (Fish)	" " " "		80	
Salt Extraction	" " " "			2000
Ice Making	" " " "			150
Milk Processing	Fort Portal			50
Tea	" "			150
Milk Processing	Mbarara			50
Textile Mill	Mbale		1000	
Meat Canning Factory	Soroti	800		
Starch Making	Lira	150		
Glass Making	Kampala		200	
Bakeries & Food Processing	"	200		
Bolts & Screws Manufacture	"		100	
Milk Processing	"	100		
Tyre Retreads	"	50		
Tobacco (Rothmans)	"	100		
Bata Shoes	"	300		
Coffee Factory	"		150	
Blanket	"	150		
Razor Blade Manufacture	"	50		
Rayon Textiles	"	150		
Carbon-Dioxide	"		200	
Woodwork	Jinja	100		
Animal Food Plant	"	200		
E. A. Steel Products	"	350		
Ice Making	"	150		
Bolts, Screws, etc.,	"	200		
Bakery	"		200	
Tractor Assembly	"			150
Cardboard Factory	"		100	
Jaggery	Bombo	50		
Maize Mill	"	50		
Irrigation (Tea)	Kibanga Port Road		100	
Sawmill	Masindi		300	
Tea	"			60
Tobacco	"			300

Table 7: ESTIMATED POWER SALES TO SPECIAL-AGREEMENT  
CUSTOMERS, 1967-75.  
(in kwh millions)

Customer	1967	1968	1970	1971	1972	1973	1974	1975	Remarks
Nyanza Textiles	92	98	108	71	35	42	42	42	All steam raising changed to oil.
				100	100	100	100	100	Only 1970 extension steam raising by oil.
Kilembe Copper	53	60	67	67	67	67	67	67	
Steel Corporation	23	49	60	70	80	90	90	90	
Cement Industry	19	19	29	38	38	38	38	38	New Factory at Kasese 1969.
New Mulago Hospital	12	12	12	12	12	12	12	12	
TOTAL	199	238	276	258	232	249	249	249	All textile steam raising changed to oil.
				287	297	307	307	307	Only 1970 textile steam raising on oil.

Table 8: ESTIMATED MAXIMUM POWER DEMANDS, 1967-75

Year	Standard Tariff MD in MW	Special Agreements MD in MW		Total Uganda MD in MW		Total MD with Kenya Bulk Supply	
		with textile steam	without textile steam	with textile steam	without textile steam	with textile steam	without textile steam
1967	42	39	39	81	81	112	112
1968	47	51	51	98	98	129	129
1969	53	57	57	110	110	141	141
1970	57	57	57	114	114	145	145
1971	63	56	42	119	<b>105</b>	150	136
1972	68	56	43	124	111	155	142
1973	74	56	43	130	117	161	148
1974	80	56	43	136	123	167	154
1975	87	56	43	140	130	171	161

NOTE: A steady 31 MW at Owen Falls has been assumed for the Bulk Supply to Kenya since this is the maximum amount of power (30 MW at Tororo) which Uganda is obliged to supply under the terms of the Bulk Supply Agreement, as amended in 1964, from the date that Kenya commissions the first generator at Kindaruma Power Station in 1967 or early 1968. In fact a higher maximum demand, up to 45 MW, may be met for some years when Uganda has surplus power, under a supplementary agreement to the Bulk Supply Agreement dated 28th October, 1964.

**Table 9: ESTIMATED ANNUAL CAPITAL EXPENDITURES**  
**OF UGANDA ELECTRICITY BOARD, 1965-75 a/**  
**(in E thousands)**

	1965 <u>b/</u> 1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	
9th & 10th Sets Owen Falls	465	200	50	100	300	150	-				
Bujugali Power Station <u>c/</u>	27	50	-	-	4,183	3,874	3,879	4,579	3,598	715	461
Minor Thermal Stations	66	-	30	-	30	-	30	-	30	-	30
Arua Hydro (Isolated)	-	-	-	-	-	100	100	-	-	-	-
Total Generation	558	250	80	100	4,513	4,124	4,009	4,579	3,628	715	491
132kv Lines Kampala & Tororo					500	500	500				
H.T and L.T Distribution	718	500	750	800	800	850	850	900	950	1,000	1,000
Total Trans. & Dist.	718	500	750	800	1,300	1,350	1,350	900	950	1,000	1,000
Administration Buildings	71	20	25	30	30	30	35	35	35	40	40
Grand Total	1,347	770	855	930	5,843	5,504	5,394	5,514	4,613	1,755	1,531
Total Foreign	877	442	555	605	4,270	3,400	3,210	3,430	3,210	1,300	1,070
Total Local	470	328	300	325	1,573	2,104	2,184	2,084	1,403	455	461

a/ Calendar years

b/ Actual

c/ Deferred two years

Table 10: ESTIMATED SOURCES & APPLICATION OF FUNDS FOR

UGANDA ELECTRICITY BOARD, 1966-75 a/

( in £ thousands )

	1965 b/	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
<b>SOURCES OF FUNDS</b>											
<u>Internal Cash</u> - Gross Income	1,831	2,272	2,692	2,946	3,408	3,776	4,157	4,112	4,487	4,817	5,066
Depreciation	887	914	945	970	1,011	1,039	1,095	1,435	1,495	1,477	1,540
SUB TOTAL	2,718	3,186	3,637	3,916	4,419	4,815	5,252	5,547	5,982	6,294	6,606
Consumers Capital Contributions	33	45	20	20	20	20	20	20	20	20	20
Interest Receivable	107	117	127	136	75	58	61	62	26	16	20
<b>Borrowings:</b>											
For Bujagali	-	-	-	-	4,500	4,000	3,500	3,000	1,000	-	-
Development Bonds	419	-	-	-	-	-	-	-	-	-	-
Available from Sinking Fund	-	-	-	-	5,200	-	-	-	1,300	-	-
TOTAL SOURCES OF FUNDS	3,277	3,348	3,784	4,072	14,214	8,893	8,833	8,629	8,328	6,330	6,646
<b>APPLICATION OF FUNDS</b>											
<b>Additions to Capital Assets</b>											
Fixed Assets	848	720	805	870	1,630	1,630	1,515	935	985	1,665	1,441
Work in Progress	482	40	50	60	3,631	3,392	3,186	3,639	3,048	90	90
Interest during Construction	17	10	-	-	282	482	693	940	580	-	-
Interest paid & charges to Revenue	1,458	1,564	1,602	1,596	1,507	1,420	1,262	1,159	1,031	2,082	2,016
<b>Loans Repaid</b>											
Development Bonds	-	300	50	100	100	100	100	100	100	100	300
3 1/2% Stock	-	-	-	-	5,200	1,100	1,100	1,100	583	-	-
4-3/4% Stock	-	-	-	-	-	-	-	-	1,300	1,100	1,100
5% Stock	-	-	-	-	-	-	-	-	-	-	1,500
Other existing loans	306	324	344	364	387	410	434	460	488	518	550
Proposed loan	-	-	-	-	-	-	-	-	-	378	401
Sinking Fund Investment	229	230	740	1,250	1,170	81	84	86	88	-	-
Compensation for loss of Office	59	78	31	34	5	5	-	-	-	-	-
TOTAL APPLICATION OF FUNDS	3,502	3,266	3,622	4,274	13,912	8,620	8,374	8,419	8,203	5,933	7,398
Cash Surplus or (Deficit)	(122)	82	162	(202)	302	273	459	210	125	397	(752)
Cumulative Surplus or (Deficit)	(601)	(519)	(357)	(559)	(257)	16	475	685	810	1,207	455

a/ Calendar years

b/ Actual

# UGANDA POSSIBLE FUTURE HYDRO-ELECTRIC PROJECTS

