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INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT
INTERNATIONAL DEVELOPMENT ASSOCIATION

APPRAISAL OF THE KIDATU HYDROELECTRIC PROJECT
OF TANZANIA ELECTRIC SUPPLY COMPANY LTD.
TANZANIA

October 8, 1970

Public Utilities Projects Department

Currency Equivalents

US\$1	=	7.14 Tanzania Shillings (Tsh)
1 Tanzania Shilling	=	US\$0.14
1,000,000 Tsh	=	US\$140,000

Abbreviations and Acronyms

kV	=	Kilovolt	=	1,000 volts
kW	=	Kilowatt	=	1,000 watts
MW	=	Megawatt	=	1,000 kilowatts
kWh	=	Kilowatt hour	=	1,000 watt hours
GWh	=	Gigawatt hour	=	1,000,000 kWh
kVA	=	Kilovolt ampere	=	1,000 volt amperes
MVA	=	Megavolt ampere	=	1,000 kilovolt amperes
m	=	Meter		
m ³	=	Cubic meter		
km	=	Kilometer		

TANESCO	Tanzania Electric Supply Company Ltd.
SIDA	Swedish International Development Authority
SWECO	Swedish Consulting Group
EAP&L	The East African Power and Lighting Company Ltd.
TIPER	Tanganyika-Italian Petroleum Refinery Company Ltd.

TANESCO's Financial Year = Calendar Year

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This report is based on the findings of a mission in April 1970 to Tanzania composed of Messrs. Erkmen, Rydell and Russell.

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TANZANIA

APPRAISAL OF THE KIDATU HYDROELECTRIC PROJECT

OF TANZANIA ELECTRIC SUPPLY COMPANY LTD.

SUMMARY AND CONCLUSIONS

- i. This report covers the appraisal of a project required to enable the Tanzania Electric Supply Company Ltd. (TANESCO) to meet the rapidly growing demand for power in its coastal system, which provides service to the Dar es Salaam, Morogoro and Tanga areas where most of Tanzania's economic activity is concentrated. The Project covers the installation of additional generation and transmission facilities, at a total cost of US\$59 million equivalent including contingencies but excluding interest during construction.
- ii. The Government of Tanzania has requested assistance from the Bank and from the Swedish International Development Authority (SIDA) in financing the Project's foreign exchange requirements, which are estimated to total US\$42 million equivalent, and would be financed by a Bank Loan of US\$30 million and by a SIDA credit of US\$12 million. The local currency requirements of US\$17 million equivalent, representing about 29% of total Project cost, would be provided by the Government as equity capital.
- iii. This would be the Bank's second lending operation in the power sector of Tanzania; the first was Loan 518 TA for US\$5.2 million to cover part of TANESCO's development program for the years 1967 through 1970. Implementation of the program is on schedule.
- iv. The growth of electricity consumption in the coastal system of Tanzania has been high, averaging more than 12% per annum since 1961; in 1969, it was 13% and is expected to reach a peak of about 19% in 1972, with the commissioning of new industrial plants now under construction. Thereafter the rate of annual growth is expected to decrease to about 10% per annum. New sources of generation will be needed by the end of 1972 to supply the coastal system. The proposed Project provides for 15 MW of interim diesel plant to be installed by then at the Ubungo generating station near Dar es Salaam and for construction of a 100 MW hydroelectric station at Kidatu on the Great Ruaha River together with a 220 kV transmission line from Kidatu to Dar es Salaam by 1975. This will meet the growing demand for TANESCO's coastal system until 1980.
- v. Tanzania has important reserves of hydroelectric potential on several rivers at sites near enough to the focal point of the coastal system to be worthy of consideration for development. The Kidatu Project represents the least-cost choice among these possible sites for meeting the estimated demand for power. In comparing the Kidatu scheme with a fuel-oil based steam alternative in Dar es Salaam, it is found that the equalizing rate of discount is more than 13% which is believed to be

above the opportunity cost of capital in Tanzania. Cost estimates are based on market trends allowing for adequate escalation of prices during the construction period and for contingencies of about 20% for the civil engineering works.

vi. Procurement of goods and services to be financed by the Bank and SIDA, with the exception of about US\$4 million for engineering services, would be on the basis of international bidding in accordance with the Bank's procurement guidelines.

vii. The Borrower would be TANESCO, a stock company with limited liability established in 1931, which is responsible for the generation and distribution of electricity throughout the mainland of Tanzania. The Government has held all the company shares since 1964. The management and about 40% of the senior staff in TANESCO are expatriates. The utility is well managed and efficient. In addition to operating the power system, it constructs woodpole transmission lines and distribution facilities. The help of consultants is required for the design and construction of other works.

viii. TANESCO's past operations have been satisfactory. Since 1966 it has achieved a rate of return in excess of 10% on its net fixed assets in operation. It is expected that TANESCO will maintain satisfactory earnings in the future.

ix. The investment requirements during the seven-year period 1970 through 1976 amount to Tsh698.2 million (US\$97.8 million) including interest during construction. Of this total, Tsh465.6 million (US\$65.2 million), or 67%, is applicable to the Bank Project. The 1970-76 program, which would increase TANESCO's fixed assets by about 200%, is expected to be financed from the following sources: internal cash generation, Tsh194.3 million (US\$27.2 million); foreign loans, Tsh359.3 million (US\$50.3 million); Government equity investments, Tsh134.8 million (US\$18.9 million); miscellaneous receipts, Tsh9.2 million (US\$1.3 million); and a grant from SIDA Tsh0.6 million (US\$0.1 million). The financial plan is satisfactory.

x. The proposed Project would form a suitable basis for a Bank Loan of US\$30 million repayable over 25 years including a 5-year grace period.

TANZANIA

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1. INTRODUCTION

1.01 The Government of the United Republic of Tanzania (the Government) has requested that the Bank, along with the Swedish International Development Authority (SIDA), finance the foreign exchange requirements of a project comprising the major part of the 1970-1975 development program of the Tanzania Electric Supply Company Ltd. (TANESCO). The Project would meet the growing demand for power until the year 1980 in the coastal area centered on Dar es Salaam and Tanga which accounts for about 80% of TANESCO's sales of electricity.

1.02 The proposed loan would be the second lending operation of the Bank Group to TANESCO. Loan 518 TA for US\$5.2 million was made in 1967 primarily for an extension of the Ubungo diesel power station and transmission and distribution, performance on which has been satisfactory.

1.03 The Project first came to the attention of the Bank in February 1966 when the Government, on behalf of TANESCO, requested the Bank's assistance in financing the foreign exchange costs of TANESCO's ten year development program covering the period from 1966 through 1975. The Bank's economic mission in 1966 found that preliminary studies of alternative power sources, including thermal developments and possible hydroelectric sites, had already been undertaken by TANESCO's consultants and a hydroelectric station at Kidatu on the Great Ruaha River selected as the most economic project for the subject of a feasibility report. Parallel with these studies the Water Development and Irrigation Division of Government had investigated and was preparing a multipurpose irrigation/hydroelectric development on the Wami River based on different assumptions, making direct comparison with the Kidatu Project impossible. The Bank economic mission in 1966 recommended that a study of the rival schemes should be prepared on a strictly comparable basis, and it was agreed during negotiations for Loan 518 TA that consultants would be engaged for this purpose. This study, jointly undertaken by Balfour, Beatty and Co. Limited of U.K. and the Swedish Consulting Group (SWECO), was completed in July 1968 and recommended the Kidatu scheme as the most economic development. A feasibility report on the Kidatu Project was received by the Bank in December 1969 following which Messrs. Erkmen, Rydell and Russell visited Tanzania in April 1970 to appraise the Project.

2. GENERAL ECONOMY AND THE POWER SECTOR

The Country and the Economy

2.01 The United Republic of Tanzania comprises mainland Tanzania (formerly Tanganyika) and Zanzibar. All references in this report are to mainland Tanzania only, which is situated on the east coast of Africa, just south of the equator. It is bordered on the north by Kenya and Uganda, on the west by Rwanda, Burundi and the Democratic Republic of the Congo and on the south by Zambia, Malawi and Mozambique. Its total area is about 362,000 square miles, including nearly 21,000 square miles of inland water. Except for a narrow coastal strip, the country lies at an altitude of over 1,000 feet, a large part being a plateau at about 4,000 feet. The population is approaching 13 million, with an annual growth rate estimated at 2.7%; urban population has been growing at over 6% p.a. Average population density is only 38 to the square mile but, since the tsetse fly makes a large part of the country uninhabitable, the bulk of the population is in the remaining areas, some of which suffer from population pressure. Dar es Salaam, the capital, has a population of 350,000.

2.02 The economy is based largely on agriculture, in which over 90% of the population is engaged, much of it at the subsistence level. Total GDP in 1968 was US\$822 million, of which agricultural output accounted for 50%, manufacturing and mining for over 8% and services (including commerce and transport) for nearly 32%. Subsistence production contributed about 28% of total GDP. According to published figures, between 1963 and 1968 total GDP grew at 4.4% at constant prices and monetary GDP at 5.1% p.a. These rates are expected to accelerate to 6.5% and 7.7% under the five-year plan, covering the period 1969-1974.* Agriculture will remain the dominant sector of the economy but will decline in relative importance as other sectors are projected to grow at faster rates, particularly manufacturing (nearly 11% p.a.), construction (10% p.a.) and commerce (8% p.a.) as against 8% and 3% respectively in the monetary and subsistence agricultural sectors.

2.03 GNP per head at about US\$80 in 1968 is the lowest among the three countries of the East African Community.** The Government's long-term objective is to raise this to US\$126 by 1980. Success in achieving this object will depend largely on the Government itself, since the main sectors of the economy are now under public control through either outright nationalization or the establishment of majority government holdings.

* The growth rate projections quoted are those of the 1969 Bank Economic Mission to Tanzania (Report No. AE 7 dated March 17, 1970).

** The corresponding figures for Kenya and Uganda in 1968 were US\$130 and US\$110 respectively.

Energy Resources

2.04 The main indigenous energy resource is hydro power. The potential available is currently estimated at 1,315 megawatts continuous. Most of this is in the basins of eight rivers draining into the Indian Ocean, although there is also scope for hydro development on three of the rivers of the Nile system within Tanzania. Only about 50 MW of hydro capacity has been installed so far, nearly all on the Pangani River.

2.05 A small quantity of coal is mined in the Songwe-Kiwiri area but commercially exploitable bulk deposits have yet to be proven. Sizeable deposits of bituminous coal have been discovered in the Ruhuhu Valley in the southern part of the country and the possibility of exploiting them in association with nearby deposits of iron ore is under study. The remoteness of this coalfield makes it unlikely that the coal would be economic for electricity generation in the coastal region in the foreseeable future. Oil exploration has been carried on for many years without success; the Government recently granted the Italian oil company AGIP exclusive prospecting rights in the coastal sedimentary belt and the continental shelf.

2.06 Firewood is the main fuel in the subsistence sector but is also used by industry for generating steam. The main commercial form of energy, however, is oil which is imported as crude and processed in the refinery at Dar es Salaam, which has a capacity of 750,000 tons p.a. It is operated by the Tanganyika-Italian Petroleum Refinery Co. Ltd. (TIPER), which is under Government control. The existing diesel power stations use oil fuel supplied from this refinery, their total consumption in 1969 being about 21,000 tons.

The Power Sector

2.07 Because it operates almost exclusively in the areas of most intensive development, the power sector has been growing much more rapidly than the economy as a whole. Sales by TANESCO, which is responsible for public supplies throughout the country, rose at an average rate of 12% p.a. between 1960 and 1969. Total investment by TANESCO during 1964-1968 amounted to Tsh214 million (US\$30 million) or about 5% of the national total of Tsh4,239 million (US\$594 million). Power investment in the Government's current plan (1969-1974) is projected at Tsh457 million* (US\$64 million), representing about 6% of the total planned national investment in the period of Tsh8,085 million (US\$1,132 million).

2.08 Industry accounts for the bulk of electricity consumption, sales to industrial users amounting to about 60% of total sales with sales to the domestic sector next at about 18%, and to the commercial sector about 16%. The sisal industry has hitherto been the main consumer in the industrial sector but its relative share has been falling with the

* At constant 1968/1969 prices.

declining fortunes of the industry - from 26% of total TANESCO sales in 1963 to around 12% in 1969.

Existing Power Facilities

2.09 Tanzania's total installed generating capacity is about 130 MW. Of this total, about 80% (102 MW) belongs to TANESCO and the remainder (28 MW) to power users who either are out of reach of TANESCO's supply lines or who find it more economical to use industrial by-products as fuel for their generating equipment. Plants already under construction and scheduled for commissioning in 1970 will bring TANESCO's installed capacity to 122 MW and the country's total to 150 MW.

2.10 TANESCO has an interconnected power system operating at 132 kV in the coastal region between Dar es Salaam, Tanga and Morogoro. Generation in the system is provided by two hydroelectric stations on the Pangani River totalling 38.5 MW, and two diesel stations close to Dar es Salaam totalling 30 MW; altogether they account for 67% of the company's total generating capacity. One of the diesel stations (Ubungo) is now being extended by about 18 MW with finance provided by Bank Loan 518 TA.

2.11 The remaining 33 MW capacity owned by TANESCO is provided by 66 diesel generating sets located at 17 different locations and seven hydroelectric sets at three locations. Diesel units vary in size from 35 kW to 2,200 kW. TANESCO's existing facilities are described in greater detail in Annex 1, and are shown on the map attached to this report.

Power Development Program

2.12 Apart from the proposed Project which will meet the growing demand in the coastal system TANESCO's development program in the period 1970-1975 includes only extensions of existing distribution facilities and construction of three small diesel stations in the townships of Mafia, Nansio and Nijombe. However a number of projects are under longer term planning including a major hydroelectric project with an ultimate capacity of about 800 to 1,000 MW at Stiegler's Gorge on the Rufiji River to supply the coastal system in the late 1980's, and 132 kV transmission line from Hale to Kikuletwa.

3. THE PROJECT

Description

3.01 The proposed Project, which would meet power generation requirements of TANESCO's coastal system up to 1980, comprises the following:

- (a) construction of the first stage (2 x 50 MW) of a hydro-electric development at Kidatu on the Great Ruaha River with related step up substation to be commissioned in 1975. The principal elements of the development include a regulating dam with a storage capacity of about 125 million m³, a head-race and a tailrace tunnel, and an underground generating station. The storage capacity is sufficient to provide at least 85 MW during peak load hours under drought conditions;
- (b) a 15 MW extension of the existing Ubungo diesel generating station near Dar es Salaam to avoid a power shortage between 1972 and commissioning of the Kidatu Project;
- (c) construction of a single circuit 220 kV, 306 km transmission line from Kidatu to Dar es Salaam, with related step down substation at Ubungo; and
- (d) Consulting services to undertake complementary studies covering the ecological effects resulting from the work under part (a) above and subsequent stages of development.

The Project is described in more detail in Annex 2, and the site of the Kidatu power station and the route of the transmission line to be constructed under the Project are shown in red on the map attached to this report.

3.02 The second stage of development planned for commissioning at the beginning of 1980 would involve the addition of a third 50 MW unit at the Kidatu station together with the construction of an earth-fill dam at Mtera located some 175 km upstream of Kidatu. This is the only site upstream of Kidatu capable of providing the storage capacity required to maintain an output of 200 MW on peak throughout the year. The third stage would consist of the addition of a fourth 50 MW unit at Kidatu in 1983.

3.03 Although there are no competing claims for the waters of the Great Ruaha River upstream of the Kidatu damsite continued availability of water in sufficient quantities for the Project and its subsequent stages is very important. During negotiations it was agreed that the Government of Tanzania will not permit any abstraction of water from the Great Ruaha River or its tributaries upstream of Kidatu that will reduce the potential output of the Kidatu generating station.

Estimated Cost

3.04 The Project cost is estimated to be Tsh422 million (US\$59 million equivalent), of which Tsh300 million (US\$42 million equivalent) would be foreign exchange. The cost of the principal features is shown below; a more detailed cost breakdown is given in Annex 3.

	In Tsh			In US\$			% of Total
	Local	Foreign	Total	Local	Foreign	Total	
	-----millions-----						
Civil Works	63.5	104.5	168.0	8.9	14.6	23.5	39.8
Elect. & Mech. Works	4.5	43.0	47.5	0.6	6.0	6.6	11.2
Transmission Line	5.5	31.0	36.5	0.8	4.3	5.1	8.6
15 MW diesel	2.5	11.5	14.0	0.4	1.6	2.0	3.3
Engin. & Super.	4.0	30.0	34.0	0.5	4.2	4.7	8.0
duties & Taxes	12.0	-	12.0	1.7	-	1.7	2.9
Contingencies	17.0	28.0	45.0	2.4	3.9	6.3	10.7
Price Escalation	<u>13.0</u>	<u>52.0</u>	<u>65.0</u>	<u>1.8</u>	<u>7.3</u>	<u>9.1</u>	<u>15.4</u>
<u>Total Construction Cost</u>	<u>122.0</u>	<u>300.0</u>	<u>422.0</u>	<u>17.0</u>	<u>42.0</u>	<u>59.0</u>	<u>100.0</u>

The proposed Bank loan of US\$30 million and the SIDA credit of US\$12 million would jointly cover the foreign exchange requirements for construction of the Project.

3.05 The above cost estimate does not include interest charged to construction totalling Tsh46.5 million (US\$6.5 million equivalent) which will be met from TANESCO's internally generated cash. The cost of preliminary investigations which amounts to about Tsh3.8 million (US\$0.5 million), and is covered by SIDA grants, is also excluded from this estimate. The provision for physical contingencies, amounting to about 11% of total cost, is composed of about 20% of the cost of civil engineering works and about 10% of the other items. This level of contingencies for civil engineering works is justified in view of the extensive underground construction involved. The local contribution to the construction of civil works will consist almost entirely of unskilled and semi-skilled manpower and the requirements of cement and timber. The proportion of foreign exchange content in the cost of civil works is therefore relatively high.

3.06 The location and dimensions of the dam, waterways and power station; size of plant and size of individual units; dimensions and voltage of transmission equipment and other parameters have all been determined by TANESCO's consultants as a result of a series of optimization studies based on the estimated load growth in the power system, on the prevailing local conditions (hydrological, geological and topographical), and on sound engineering principles, to give the minimum present cost over the life of the Project. In these studies special attention was given to the optimum size of individual units. The alternative of delaying the construction of the hydroelectric station and the interim installation of thermal sets (diesel, gas turbine or steam) in 15 and/or 30 MW sizes up to a total of 75 MW, was also considered.

3.07 The costs of the second and third stages of the Kidatu hydro-electric development are estimated to be US\$13.5 and US\$4.6 million equivalent, respectively, giving a total of US\$18.1 million. One reason for the comparatively low cost of these later stages is that the first stage Project includes underground excavations related to the second and third stages. It is therefore desirable that further stages of Kidatu scheme be completed before other major projects are developed for the purposes of meeting additional demand in the power system to which Kidatu power station would be connected unless it can be shown that the alternative would be more economical. During negotiations the Government agreed to ensure that TANESCO will extend the Kidatu scheme so long as studies show to the satisfaction of Tanzania and the Bank that such course would be the most economical means of producing additional power for the system. Investments for up to 15 MW are excluded from this restriction so that TANESCO has the flexibility to deal speedily with unusual circumstances and minor requirements in other supply areas.

Status of Engineering, Procurement

3.08 For the design, preparation of bidding documents, bid evaluation and supervision of all works included in the Project, TANESCO has engaged the Swedish Consulting Group (SWECO) of Stockholm, a joint enterprise in which ten Swedish consulting firms participate. SWECO was responsible for the July 1968 Study (see paragraph 1.03) along with Balfour, Beatty & Co., Ltd. of the United Kingdom. SWECO also prepared the feasibility study for the Kidatu scheme and is acceptable to the Bank.

3.09 A general ecological review of the Kidatu and Mtera reservoir proposals was completed in September 1970. An in depth study of some aspects of the ecology recommended in the general review is already underway. This study which is estimated to take about a year is expected to lead to the development of measures required to mitigate any adverse effects and make recommendations with regard to further development of beneficial effects in the fields of game preservation, fishing, etc.

3.10 An access road of about 11 km to the dam site is already under construction. Site investigations for Kidatu civil engineering works are completed, and design and preparation of bidding documents are underway. Survey of the route of the 220 kV transmission line is being conducted by SWECO, and design is proceeding. Design work for the 15 MW diesel installation is completed.

3.11 Procurement of goods and services to be financed by the Bank and SIDA would be on a basis of international competitive bidding, with the exception of about US\$4 million for the professional engineering services. SIDA has requested that the Bank supervise all procurement for the Project.

Disbursements

3.12 The foreign currency costs already incurred or committed for the site investigations, engineering and access road up to the time of completing financial arrangements are estimated to amount to about US\$1.0

million. SIDA has indicated that it would disburse against these costs, provided that after the effective date of the Bank loan the Bank would disburse up to an amount equal to the SIDA disbursement multiplied by the loan-to-credit ratio of 30/12. Thereafter, disbursements would proceed in parallel in the same ratio against the actual foreign exchange component of (a) cost of consultant's services and imported goods, and (b) cost of erection and construction as specified in the contracts. These arrangements have been confirmed during negotiations.

3.13 The schedule of disbursements from the proposed Bank loan is shown in Annex 4. Any part of the proposed Bank loan not needed to meet the Project's foreign exchange costs should be cancelled.

Construction Schedule

3.14 It is necessary to commission the 15 MW diesel equipment before the end of 1972 and the first machine at Kidatu by mid-1975 if the expected demand is to be met. To ensure that the commissioning date for the Kidatu equipment can be achieved, the bidding documents for civil engineering works are already issued and the main contracts are expected to be placed before the end of 1970. Provided there are no unforeseen delays, it should be possible to achieve these target dates.

3.15 Projected maximum demand in TANESCO's coastal system is shown in Annex 5 together with system installed and firm capacity curves corresponding to the above construction schedule.

3.16 The transmission line from Kidatu to Dar es Salaam is scheduled for completion at the end of 1974 to ensure there will be no delay in commissioning Kidatu if progress in construction of the power station is ahead of schedule.

4. JUSTIFICATION OF THE PROJECT

Market Growth

4.01 The Project would form a part of the interconnected coastal system of the TANESCO supply area. This system accounted for about 80% of total TANESCO sales in 1969. It includes the capital, Dar es Salaam (population 350,000), where most of the commercial and industrial development in the country is concentrated, as well as the important urban centers of Tanga (population 70,000) and Morogoro (population 30,000). The average rate of growth of electricity sales in the system since 1960 has been 12.4% p.a. Within the total, industrial sales have been growing at 13.5% p.a., commercial sales at 16.3% p.a., and domestic sales at 6.9% p.a. The detailed figures by consumer category for the main load centers are shown in Annex 6 together with the corresponding trends in maximum demand and generation.

4.02 The TANESCO forecast of sales up to 1985 for the area to be served by the Project is shown in Annex 7. This is an updated version of a projection prepared in 1968 by the British consulting firm of Merz and McLellan. The method used was to establish the underlying growth rate of past sales by eliminating major new loads as they occurred and to project this rate into the future, adding in known or anticipated new loads over the next few years and assuming a stabilizing of the rate of growth thereafter. The resulting forecast shows a rate of growth averaging about 12.1% p.a. up to 1975, falling subsequently to around 10% p.a. This is higher than the rates being assumed in the other two member countries of the East African Community, Kenya and Uganda, which are 9% and 6% respectively. A higher growth rate is to be expected in Tanzania, however, as electricity consumption per head is much lower - 24 kWh in 1969, against 53 kWh for Kenya and 47 kWh for Uganda. Moreover, Tanzania has in the past relied to a considerable extent on secondary industries in Kenya and Uganda. The present trend towards developing parallel industries in Tanzania not only increases the demand for power in Tanzania but for a while at least depresses the rate of growth in the other two territories. The forecast also looks reasonable in relation to the Government's plans for raising the rate of growth of the economy to 6.5% p.a. compared with an average in recent years of about 5% p.a.

4.03 The TANESCO forecast has been checked by making independent projections based on the relationships between electricity sales, monetary GDP, industrial output and urban population as established by statistics for the period 1960-69. The method is explained in Annex 8, which also shows the resulting projections of electricity sales. These show average annual growth rates ranging from 10% to 12.5%, compared with the TANESCO figure of 11%. The effects on the economics of the Project of different growth rates are considered in paragraph 4.07 below.

Comparison of Alternatives

4.04 The alternative to the present Project would be another hydro scheme or a thermal station. Nine alternative hydro schemes were examined by TANESCO's general consultants, Balfour, Beatty & Co., Ltd of U.K., in a series of studies carried out over the past 4-5 years (see Annex 9). Most of these were eliminated from detailed consideration because they were too remote, too small, or geologically unsatisfactory. Stiegler's

Urgo was eliminated because the site could only be economically developed with much more capacity than the TANESCO system could absorb for many years to come (see paragraph 2.12). The choice was finally narrowed down to two schemes at Pongwe on the Wami and at Kidatu on the Great Ruaha River (see paragraph 1.03). A comparative study of the two schemes showed that the Wami scheme would have a much lower output than Kidatu and would have to be supplemented by additional thermal plant raising the estimated capital cost to US\$92.5 million compared with US\$68 million for Kidatu. The annual costs attributable to these two alternatives are equivalent to power costs in Dar es Salaam of about 9 and 6 US mills/kWh respectively.

4.05 The Kidatu scheme was therefore chosen as the preferred hydro development and compared with an alternative thermal development based on a steam station at Dar es Salaam using residual fuel oil from the TIPER refinery. For this purpose it was necessary to compare two alternative programs of development; the first comprising the Project plus a further 100 MW of hydro capacity to complete the Kidatu development (see Annex 9); the second consisting of 210 MW of steam capacity, to be installed in 30 MW stages in accordance with the projected growth of demand. An oil price of Tsh85 (US\$12) per long ton was assumed (see Annex 10).

4.06 The hydro based program has higher capital costs but much lower running costs. A comparison of the discounted cash flows, both capital and operating, of the two alternatives over a period of 60 years, using the TANESCO load forecast and the consultants' estimates of capital and running costs (see Annex 10), showed that at a cost of capital up to 13% the Kidatu scheme is the preferred alternative.

4.07 The sensitivity of the discount rate to different assumptions about the main variables (load growth, capital costs, running costs) was tested, as described in Annex 10. This shows that a variation in the price of oil of $\pm 20\%$ would reduce or raise the equalizing discount rate by about 1.5 percentage points. A variation in load growth of $\pm 20\%$ would raise or lower the rate by 0.5 percentage point. A 3% annual escalation of all costs (other than the cost of oil) would improve the advantage of the hydro alternative, raising the equalizing discount rate by about 1 percentage point. As shown in Annex 10 the equalizing discount rate is unlikely to be less than 12%, which adequately justifies the higher capital costs of hydro development at Kidatu since the opportunity cost of capital in Tanzania is believed not to exceed 12%.

Incremental Rate of Return

4.08 The incremental financial rate of return on the Project, calculated by finding the discount rate which equates the present values of the estimated capital and operating expenditures of the Project over its life (excluding taxes and depreciation) and the revenues attributable to it, is estimated at 16%. A sensitivity analysis shows that the return could be between 10% and 19% depending on the rate of load growth and other factors (see Annex 11). This is satisfactory.

5. THE BORROWER

5.01 Tanzania Electric Supply Company Limited (TANESCO), the Borrower, was founded as a private company in 1931. It was acquired by the Government of Tanzania in 1964 through purchase from the East African Power and Lighting Company Ltd. (EAP&L) of Kenya of all the issued shares other than those already held by the Government. Payment is being made over a 12-year period by means of bills of exchange dated at six-month intervals. There are ten shareholder nominees; they attend the general meetings of the Company, whose business is conducted in accordance with the Companies Ordinance (Chapter 212 of Revised Laws of Tanganyika Territory, 1947). The majority vote is vested in the Registrar of the Treasury, one of the shareholder nominees. TANESCO has been made responsible for the development of the country's power industry, and it functions as the sole organization for the public generation and distribution of electricity throughout mainland Tanzania. It operates in accordance with commercial principles.

Company's Memorandum of Association and Licenses

5.02 The Company's Memorandum of Association dated September 21, 1931 defines the objectives of the Company as follows: "to acquire concessions for the sole and exclusive right to produce, distribute, supply and sell electrical energy within the area of Tanganyika, and to undertake all kinds of financial, commercial, trading and other operations, and to carry on any other business (except life insurance) which may seem to be capable of being conveniently carried out in connection with the main objectives of the Company or render profitable any of the Company's property or rights."

5.03 Issued in 1957 under Electricity Ordinance No. 3 (Chapter 131 of the Laws), and expiring in the year 2012, the Company's licenses provide for it to have first refusal of any additional areas to be licensed for public supplies of electricity in Tanzania. The licenses define areas of "compulsory supply" within which the Company is obliged to provide a supply upon payment of the required charges by the consumers, and lay down maximum rates (see paragraph 6.01) for the sale of energy for lighting and power.

5.04 The licenses also make provisions for the designation of power development reserves at potential hydroelectric sites on rivers throughout the country, water rights on the Pangani River, the right to export power to neighboring countries, increases in maximum rates in event of tax increases, the right to charge interest to capital account during construction of projects, and the usual rights and obligations to protect the interests of the Company and its consumers.

5.05 The Company's Memorandum of Association and Licenses are acceptable to the Bank.

Organization and Management

5.06 The Company's Board of Directors is composed of a full-time Executive Chairman and eight part-time members: five are high-ranking officers of various Ministries, two are the general managers of industrial

enterprises, and one represents EAP&L (the right to nominate a member until payment is complete was given EAP&L when it agreed to sell its shares in the Company in 1964). TANESCO continues to operate on the same commercial principles as it did before Government purchased all the shares in the Company.

5.07 Despite the changes in ownership described above, continuity of management has been maintained. Since 1955, the General Manager has changed only once -- in 1965, due to retirement. At that time a replacement expatriate was provided for five years under a British Government technical assistance program. In 1970, TANESCO renewed his contract for two years, the duration of contract being in accordance with the standing practice for all contracts with expatriates in Tanzania.

5.08 TANESCO employs 50 expatriates, mostly in senior technical posts; 12 are permanently employed while the remaining 38 have two-year contracts. Company policy is to fill all vacancies with citizens of Tanzania when practicable; to promote existing staff to fill senior vacancies on the basis of merit and to offer training opportunities to those employees who possess basic qualities which can be developed to fit them for senior posts of responsibility when such vacancies occur. This policy which is being prudently applied so as to maintain efficiency has brought about an increase in the percentage of Tanzanians in both total staff and senior staff positions, as shown in the table below.

<u>Year</u>	<u>Percentage of Tanzanian Citizens</u>	
	<u>In Total Staff</u>	<u>In Senior Staff Posts</u>
1964	87	19
1965	88	24
1966	90	34
1967	92	46
1968	94	62

5.09 TANESCO's total staff of 3,011 at first sight appears large for a sales volume of about 307 million kWh providing service to some 46,000 consumers when judged by the standards of more highly developed countries. This staffing is justified, however, since power generation is divided among 94 units of which 80 are diesel sets at 19 different locations. Day to day operations are handled by men on the spot at isolated branches separated by some hundreds of miles and poor communications, the smallest having a sales volume as low as 173,000 kWh per annum and serving only 207 consumers. Moreover, TANESCO staff is responsible for the design and construction of all distribution facilities as well as all woodpole transmission lines. The staff is successfully carrying out the project financed by Loan 518 TA which includes an 18 MW extension of the Ubungo diesel station near Dar es Salaam, now practically completed, plus other works.

5.10 The company normally employs consultants and contractors for all major power station and transmission developments. As now constituted, the management and staff of the Company are competent to carry out the proposed Project with the assistance of consultants. During negotiations TANESCO

has agreed that (a) it shall at all times employ a general manager whose experience, qualifications, responsibilities and functions are mutually satisfactory to the Bank and the Company; (b) it shall continue to appoint, retain or promote sufficient qualified and experienced staff to enable the Company to conduct its operations efficiently; and (c) in carrying out the Project the Company shall continue to employ consultants acceptable to the Bank upon terms and conditions satisfactory to the Bank.

Training

5.11 TANESCO has accelerated its training activities, especially since 1968 when it established and made operational a training school with two workshops, three lecture rooms and a cinema for education films. It is understood that SIDA intends making a grant to the Government to cover the costs of a study of the Company's training needs and of ensuring measures to be taken as a result of the study.

6. FINANCIAL ASPECTS

Tariffs

6.01 Tariffs in Tanzania are controlled by the Electricity (Amendment) Ordinance of 1957 and also by the license issued by the Government. The Ordinance prohibits the licensee from charging tariffs in excess of the maximum prices as stated in the license; but within such limitations, tariffs may be changed by TANESCO, upon Government approval, at the end of each three-year period. The maximum rates prescribed in the 1957 license are so high (for light Tsh1.20 per kWh (UScents 16.8) and for power Tsh0.60 per kWh (UScents 8.4) compared to the 1969 average actual rate of Tcents 23.65 per kWh (UScents 3.31)) that it is unlikely that TANESCO will find it necessary to request increases in these maximum rates.

6.02 TANESCO, upon its own initiative and without further reference to the Government, may increase tariffs previously approved by the Government by up to 10%, provided such increase does not exceed the maximum rates in the license. Increases in excess of 10% must have Government sanction, but such new price levels then become the basis for any additional increases of up to 10% without Government approval. Subject to these restrictions, TANESCO may at any time increase its tariffs to cover increases in taxes on electrical energy or taxes on fuel.

6.03 Prior to February 1, 1966, tariffs were maintained at the same level for several years but were not standardized throughout all areas served by TANESCO. Revised tariffs became effective February 1, 1966, whereby the average rate per kWh was increased about 17%, with Government approval, and rates became standardized throughout the country. Since that time, while tariffs have remained unchanged, the average annual price per kWh has decreased slightly because of increased consumption at lower tariff rates.

6.04 The existing Loan Agreement No. 518 TA required TANESCO (a) to take all steps necessary to achieve a 10% return on its average net fixed assets in operation, and (b) not to reduce its then prevailing tariffs during the construction period of that project. TANESCO is expected to achieve a return in excess of 10% during each year 1970 through 1974. Reflecting the very substantial increase in its rate base due to commissioning of Kidatu Stage I, the return is expected to drop to 9.3% and 6.9% in 1975 and 1976, respectively; thereafter, with the expected steady increase in utilization of the Project's capacity, the return should improve annually, reaching 10.5% in 1982. Since no financial reasons are presently apparent which would make necessary a tariff increase during the expected six-year period of below 10% returns it was agreed during negotiations that a rate covenant would be included in the proposed loan requiring that, unless the Bank shall otherwise agree, TANESCO will: (a) take all steps necessary to achieve an annual rate of return of not less than 10% on its average net fixed assets in operation, except in respect of the years 1975 through 1981, during which the annual rate of return may not be less than 7%, and (b) make no reduction in its presently prevailing tariffs through the year 1981.

Past Operating Results

6.05 The table below summarizes the trend in sales during the period 1966 through 1969:

<u>Year</u>	<u>Units Generated</u> kWh Million	<u>Units Sold</u>		<u>Sales Revenue</u> Tsh'000
		<u>kWh Million</u>	<u>Annual %</u> <u>Increase</u>	
1966	252	215	19	54,440
1967	282	240	12	59,857
1968	313	266	11	65,762
1969	358	307	15	72,608

6.06 The difference between kWh generated and kWh sold represents TANESCO's own consumption and power losses. The annual percentage of units sold to units generated has been maintained at about 86% which is considered satisfactory for an extended power network such as TANESCO's. The irregular trend in sales is due mainly to a depressed sisal market and the addition of new large consumers. Income statements for the four years, 1966 through 1969, are shown in Annex 12.

6.07 In 1966 the operating ratio (operating expenses including depreciation and taxes/operating revenues) was about 65%. During the following three years this ratio increased to about 69%, mainly because of a substantial increase in income taxes. Operating costs per kWh sold, excluding income taxes, decreased from Tcents 15.12 (UScents 2.12) in 1966 to Tcents 14.44 (UScents 2.02) in 1969.

6.08 Operating income increased from Tsh19.4 million in 1966 to Tsh22.6 million in 1969. During these four years, TANESCO achieved an annual rate of return varying between 10.2% and 11.3%. Annual interest coverage was very high, about 4 times or more during this period, which indicates TANESCO's capacity to generate sufficient funds for its past expansion program with the result that long-term debt was held at a very low level. Since 1966, TANESCO has paid an annual dividend of 6-2/3% on the outstanding share capital and the balance of net income has been allocated to provisions for deferred income taxes (see paragraph 6.13) and to earned surplus.

Present Financial Position

6.09 A summary of the latest balance sheet at December 31, 1969 is shown in the following statement:

Summary Balance Sheet
December 31, 1969

<u>ASSETS</u>	<u>Amount (Millions)</u>	
	<u>Tsh</u>	<u>US\$ Equivalent</u>
<u>Fixed Assets</u>		
Gross fixed assets in operation	347.8	48.7
Less reserve for depreciation	111.0	15.5
Net fixed assets in operation	236.8	33.2
Work in progress	28.3	4.0
Total Fixed Assets	265.1	37.2
<u>Current Assets</u>	28.8	4.0
Total Assets	293.9	41.2
<u>EQUITY AND LIABILITIES</u>		
<u>Equity</u>		
Ordinary Stock	111.1	15.6
Surplus	1.6	0.2
Reserves	33.8	4.7
Total Equity	146.5	20.5
<u>Long-Term Debt</u>	84.6 ^{1/}	11.9
<u>Current Liabilities</u>	22.6	3.2
<u>Contributions in Aid of Construction</u>	12.0	1.7
<u>SIDA Grant</u>	3.2	0.4
<u>Accumulated Deferred Income Taxes</u>	25.0	3.5
Total Equity and Liabilities	293.9	41.2

1/ Includes Tsh6.2 million (US\$0.9 million) long-term debt due within one year.

6.10 TANESCO's financial position at the end of each year, 1966 through 1969, is shown in the balance sheets, Annex 13. Gross fixed assets in operation are stated at original cost. Tanzania's currency exchange rate has a long record of stability; its internal price level has been relatively steady; and no problem arises at this time as to valuation of its fixed assets. The above summary statement shows a satisfactory financial position as of December 31, 1969. Including long-term debt due within one year as current liabilities, the current ratio is 1/1. The debt/equity ratio is 37/63, again reflecting a conservative pattern of past financing.

6.11 Details of the long-term debt of Tsh84.6 million are shown in Annex 14.

6.12 The outstanding debenture stock of Tsh48.4 million (US\$6.8 million) requires special mention. This debt, held by the Commonwealth Development Corporation, was incurred in 1961 in connection with construction of the Hale Hydroelectric station. It is repayable in 17 annual

installments ending in 1985, and was secured by a first mortgage on all then existing freehold and leasehold properties of TANESCO and on all such property acquired in connection with the Hale project, plus a floating charge over all other properties of TANESCO owned at that time or subsequently acquired. In order to provide adequate security under these conditions for Bank Loan No. 518 TA, it was necessary to open up the existing mortgage deed so as to include the Bank Loan in the security on a pari passu basis. The same situation will arise with respect to the proposed Bank loan, and during negotiations assurances were obtained that the existing mortgage will be reopened so as to include the proposed loan in the security as soon as practicable but not later than September 30, 1971.

6.13 In 1969, TANESCO established an Accumulated Deferred Income Taxes account in the amount of Tsh25.0 million (US\$3.5 million) by allocation of amounts from surplus and general reserve accounts. This new account represents accumulated tax savings of prior years which resulted from a Government policy to encourage expansion and development. This policy allows a liberal tax deduction of 12-1/2% on the declining balance of fixed assets in operation in lieu of normal depreciation charges, which in the case of TANESCO would be about 3-1/2% of gross plant in operation. The accumulated deferred taxes are potentially payable at some future time. However, assuming continuation of the liberalized depreciation policy, this is not expected to occur in the foreseeable future since TANESCO's substantial construction program will by 1976 increase its depreciable property by about 200% and result in further large annual tax savings in this period and beyond.

Audit

6.14 For the past several years, TANESCO's accounts have been audited by Messrs. Gills and Johnson, Chartered accountants, a local firm associated with the British firm of Deloitte, Plender, Griffiths and Company. These arrangements have been satisfactory. Bank Loan No. 518 TA requires TANESCO to continue employing auditors satisfactory to the Bank and such a covenant has been repeated in the proposed loan agreement.

Accounting

6.15 TANESCO has a capable accounting staff, under the direction of qualified professional accountants. It employs a satisfactory accounting system and its records are maintained on a current basis. Most of the accounting functions are centralized at TANESCO's headquarters in Dar es Salaam. All billings are currently being recorded on computer equipment at the head office. TANESCO has had a good collection record in the past. The average number of days receivables outstanding is about 40.

6.16 In 1968, TANESCO entered into a two-year contract with International Computer Limited of U.K. for leasing computer equipment at an annual rental of Tsh360,000. This contract expired in April 1970 and was renewed for another two years. The computer division is well managed and after overcoming the usual problems with the installation of a computer system, it has been operating satisfactorily. Cost studies have been made and TANESCO estimates that in 1970 it will break even on the cost of the

computer system and thereafter it expects to attain annual savings.

Proposed Financing Plan

6.17 A summary of the financing plan is presented in the following statement showing the funds required and the sources of such funds during the seven-year period 1970 through 1976 :

	Amount (Millions)		
	Tsh	US\$ Equivalent	%
<u>Required Funds</u>			
<u>Construction Expenditures</u>			
IBRD Loan 518 TA project	35.6	5.0	5.1
Proposed IBRD Project	419.1	58.7	60.0
Other construction	176.6	24.7	25.2
	<u>631.3</u>	<u>88.4</u>	<u>90.3</u>
Interest during construction	47.8	6.7	6.9
Total construction expenditures	<u>679.1</u>	<u>95.1</u>	<u>97.2</u>
<u>Increase in Net Working Capital</u>	<u>19.1</u>	<u>2.7</u>	<u>2.8</u>
Total Required Funds	<u>698.2</u>	<u>97.8</u>	<u>100.0</u>
<u>Sources of Funds</u>			
<u>Net Internal Cash Generation</u>			
Internal cash generation	400.4	56.1	57.4
Less: Interest charged to operations	70.9	9.9	
Amortization of long-term debt	48.2	6.8	
Dividends paid	87.0	12.2	
Total deductions	<u>206.1</u>	<u>28.9</u>	<u>29.5</u>
Net internal cash generation	<u>194.3</u>	<u>27.2</u>	<u>27.9</u>
<u>Borrowings</u>			
IBRD Loan 518 TA	20.0	2.8	2.9
Proposed IBRD Loan	214.2	30.0	30.7
Proposed SIDA Credit	85.7	12.0	12.3
Other	39.4	5.5	5.6
Total borrowings	<u>359.3</u>	<u>50.3</u>	<u>51.5</u>
<u>Other Sources</u>			
Equity Investments	134.8	18.9	19.2
Miscellaneous Receipts	9.2	1.3	1.3
SIDA Grant	0.6	0.1	0.1
Total other sources	<u>144.6</u>	<u>20.3</u>	<u>20.6</u>
Total Sources	<u>698.2</u>	<u>97.8</u>	<u>100.0</u>

6.18 TANESCO's net internal cash generation, based on the revenue forecast as indicated in the forecast income statements (Annex 12), is expected to provide Tsh194.3 million or about 28% of the total fund requirements after covering interest charged to operations, amortization of long-term debt and dividends. Although a 28% contribution by TANESCO towards the fund requirement may appear somewhat low it is adequate during this period of exceptionally high capital expenditures which will increase the fixed assets of the company by about 200% in a relatively short period of time (see Annex 13).

6.19 Of the total estimated Tsh359.3 million funds from borrowings, Tsh22.4 million, or about 6%, will be provided from undrawn balances of existing loans. The proposed IBRD and SIDA financing will provide Tsh299.9 million, or about 84% of the total borrowings. It has been assumed for the purpose of the financial forecast that the Bank loan of Tsh214.2 million (US\$30.0 million) would carry a 7-1/4% interest rate and would have a term of 25 years including a 5-year grace period. The SIDA credit of Tsh85.7 million (US\$12.0 million) will be made directly to the Government and relent to TANESCO on terms similar to the terms of the proposed Bank loan. The SIDA credit will be made effective prior to or simultaneous with the effectiveness of the proposed Bank loan. At present no definite arrangements have been made for the estimated remaining loans amounting to Tsh37.0 million, or about 10% of the total borrowings, because most of these funds (for a transmission line between Hale and Kikuletwa and for the second stage of Kidatu) will not be required until 1974 and thereafter. No difficulty is expected in obtaining this additional financing at the appropriate time.

6.20 The balance of the required funds over the period 1970 through 1976 will be supplied by Government equity investments of Tsh134.8 million or 19.2% of the funds required, by miscellaneous receipts of Tsh9.2 million (1.3%), and by a small grant from SIDA covering the cost of preliminary investigations to be incurred in 1970.

6.21 A Source and Application of Funds Statement is shown in Annex 15. The financing plan is satisfactory. However, to assure that the Project will not be delayed because of unexpected shortage of funds during the years 1970 through 1976, assurances were obtained: (a) that unless the Bank agrees otherwise the present dividend rate of 6-2/3% paid to the Government on the ordinary stock will not be increased during the period 1970-1976, and (b) in the event of a shortage of funds, that the Government will supply TANESCO with such funds as are necessary to carry out the timely completion of the Project, on terms and conditions satisfactory to the Bank.

Future Operations

6.22 Based on the present market forecast and on the existing tariffs, TANESCO's total operating revenue is expected to double, from Tsh74.1 million in 1969 to Tsh148.2 million in 1977. Although operating expenses are expected to increase between 1969 and 1974, they are reasonable in

relation to increased production and the expanded power system. The cost per kWh sold, excluding income taxes, is expected to decrease from Tcents 14.44 (UScents 2.02) in 1969 to Tcents 11.80 (UScents 1.65) in 1974. In 1975, when Kidatu Project Stage I comes on stream the cost per kWh should increase slightly to Tcents 11.96 (UScents 1.67) because of the substantial depreciation charge associated with the Project which more than offsets savings in other operating expenses resulting from the use of hydro power. By 1977, however, as the savings in other operating expenses increase, the cost per kWh sold should decrease to Tcents 11.41 (UScents 1.60).

6.23 TANESCO's current position should be satisfactory as indicated by the current ratio (including long-term debt due within one year as a current liability) which is 1/1 or better in seven years of the eight-year forecast period. A temporary shortage of cash is expected to occur at the end of 1975, and TANESCO plans to cover this by a bank overdraft which would be repaid in early 1976.

6.24 The relationship of long-term debt to equity is satisfactory. The debt/equity ratio increases steadily each year from 37/63 in 1969 to a high of 54/46 in 1976 which is reasonable, reflecting an increasing rate of borrowing to finance its heavy expansion program. The ratio declines slightly in 1977 and should continue decreasing in subsequent years until the next major construction project requiring extensive borrowing is undertaken.

6.25 The first Bank loan to TANESCO included a debt limitation covenant to the effect that, except as the Bank shall otherwise agree, TANESCO shall not incur any debt unless the internal cash generation is at least 1.5 times the maximum future debt service, calculated on the basis of amounts drawn down. A similar covenant has been included in the proposed loan agreement. However, to facilitate the administration of the covenant it was changed so as to require that (i) debt shall be deemed to be incurred on the date of execution of a loan contract, and (ii) the maximum future debt service shall be covered not less than 1.4 times. The financing plan for the 1970-76 construction program includes a proposed loan to be contracted for in 1973, followed by another foreign loan in 1975 (Annex 15). The present financial forecasts indicate that TANESCO may not be able to meet the 1.4 times coverage test of the proposed covenant in respect of the 1973 loan, in which event the problem could be reassessed in light of the then prevailing circumstances. The test for the 1975 loan could apparently be met without difficulty.

7. RECOMMENDATIONS

7.01 During loan negotiations agreement was reached on the following principal points:

- (a) The Government of Tanzania shall not permit any abstraction of water from the Great Ruaha River or its tributaries upstream of Kidatu that will in any way reduce the potential output of the Kidatu generating station (paragraph 3.03);
- (b) TANESCO shall extend the Kidatu scheme so long as studies show to the satisfaction of Tanzania and the Bank that such course would be the most economic means of producing additional power for the system to which Kidatu is interconnected (paragraph 3.07);
- (c) except as the Bank shall otherwise agree, (i) revenues will be sufficient to earn an annual rate of return of not less than 10%, except for the years 1975 through 1981, when the rate of return may not be less than 7%; and (ii) the presently prevailing tariffs shall not be reduced through the year 1981 (paragraph 6.04); and
- (d) the proposed loan will be secured under the existing mortgage as soon as practicable but not later than September 30, 1971 (paragraph 6.12).

7.02 The SIDA credit will be made effective prior to or simultaneous with the effectiveness of the proposed Bank loan (paragraph 6.19).

7.03 The proposed Project constitutes a suitable basis for a Bank loan of US\$30 million, for 25 years including five years of grace.

October 8, 1970

TANZANIATANZANIA ELECTRIC SUPPLY COMPANY LIMITED.TANESCO'S EXISTING POWER FACILITIES

1. TANESCO has an interconnected power system operating at 132 kV in the coastal region between Dar es Salaam, Tanga and Morogoro. This system accounts for 67% of the company's installed generating capacity, 63% of its 46,000 electricity consumers, and about 80% of its total 1969 sales of 307 million kWh. These figures reflect the concentration of urban population and general economic activity in the coastal region. Other population centers with considerable economic activity include -- the Moshi-Arusha* area in the foothills of Mount Kilimanjaro, with an installed capacity of 15 MW, the Mwanza area in the Lake Victoria region (7.5 MW), the Mtwara-Lindi area in the south coastal region (2.6 MW), and the towns of Iringa, Dodoma and Tabora in the central plateau, with an installed capacity among them of 4 MW. Ten other population centers have public supplies of electricity, with generating equipment ranging from 145 to 800 kW installed capacity. The locations of the interconnected power system and of the other centers with public supplies are shown on the map attached to the report.
2. Hydroelectric power plant owned by TANESCO has a total capacity of 48 MW, consisting mainly of 17.5 MW at Pangani Falls, 21 MW at Hale and 8 MW at Nyumba-ya-Mungu. All these stations are on the Pangani River, the first two feeding into the coastal system and the other into the Moshi-Arusha system. Both the Pangani Falls station built in 1934 and the Hale station built in 1964 are run-of-river type with limited pondage. The river flow is controlled upstream at Nyumba-ya-Mungu, where a dam creating a large multipurpose reservoir of 1,500 million m³ was constructed in 1967. The Nyumba-ya-Mungu Power station was added in 1969. A small hydroelectric station of 1.2 MW built in 1935 at Kikuletwa on the Pangani River supplies the towns of Moshi and Arusha. Another small hydroelectric plant of 0.3 MW on the Mwaya River has been supplying the town of Mbeya since 1958.
3. The remaining 53.8 MW capacity owned by TANESCO is provided by 80 diesel generating sets, at 19 different locations. These units vary in size from 35 kW to 4,400 kW. Under Bank Loan 518 TA, the Ubungo station is now being extended with three 6,100 kW units and the Mwanza station on Lake Victoria with two 1,500 kW units. The installed capacity, maximum demands and kWh sales for 1969 at all TANESCO branches are shown at the end of this Annex.

* Arusha is the capital of the East African Community.

4. The coastal system is interconnected by means of 132 kV single circuit transmission lines on stayed steel towers totalling about 370 km in length. In the Moshi-Arusha system a 66 kV line of 33.5 km in length carries power from Nyumbu-ya-Mungu station to the load centers in the north. The operating voltage for the secondary transmission lines in both systems is standardized at 33 kV. For distribution networks two standard voltages (11,000 and 400 volts) are adopted. In spite of long transmission distances and high incidence of lightning, the reliability of supply is well maintained. Transmission and distribution losses expressed as a fraction of units sent out are 13% which is satisfactory.

5. The TANESCO transmission system is shown on the map attached to the report. Two main transmission lines are currently under construction: a 132 kV line from Hale station to Tanga to meet the growing demand brought about by the town's fertilizer plant and steel rolling mill now under construction, and a 33 kV line from Mtwara to Lindi which will make it possible to shut down the small and costly diesel plant at Lindi.

List of Capacity, Demand and Sales

	Capacity (kW)	1969 Demand (kW)	1969 Sales (000 kWh)
Coastal System	68,380	51,300	243,698
Moshi-Arusha System	15,160	10,910	26,465
Bukoka	800	470	1,444
Dodoma	1,210	910	3,804
Iringa	1,670	870	3,837
Kigoma	720	280	915
Lindi	440	202	611
Mbeya 1/	660	675	2,358
Mpwapwa	240	94	218
Mtwara	2,175	560	1,753
Musoma	500	240	545
Mwanza	7,560	4,100	15,491
Nashingwea	250	120	333
Singida	360	180	517
Songea	380	75	new
Tabora	1,110	790	2,692
Tukuyu	145	78	173
Shinyanga 2/	-	600	1,923
TOTAL	101,760		306,777

1/ A diesel unit of 380 kWh is being transferred from Mwanza.

2/ Power is purchased from Williamson Diamond Mines.

July 23, 1970

TANZANIA
TANZANIA ELECTRIC SUPPLY COMPANY LIMITED
DESCRIPTION OF KIDATU HYDROELECTRIC DEVELOPMENT

Topography and Hydrology

1. The Great Ruaha River, an important tributary of the Rufiji River rises in the mountainous south-western region of Tanzania, close to northern tip of Lake Nyasa where the rainfall is one of the heaviest in the country. From there it flows in a north easterly direction until it reaches Mtera where other major tributaries join it and the flow turns in a south easterly direction. The river falls about 175 m over a distance of about 34 km before it reaches the Mikumi-Ifakara road bridge at Kidatu and then it enters a long flat plain flowing at a gentle gradient in mainly easterly direction until it joins the Rufiji River.
2. At Kidatu where the proposed hydroelectric development is located the average flow of Great Ruaha River is $191 \text{ m}^3/\text{s}$ which corresponds to a theoretical annual flow of 6,025 million m^3 . However direct discharge measurements obtained over a period of 14 years from 1954 to 1968 (and supplemented by earlier rainfall measurements) show that the annual flow varies from year to year between 1,665 million m^3 and 17,650 million m^3 . In addition to these annual variations, the discharge figures show a greater seasonal variation. Between wet and dry months of the same year the discharge variations may show a ratio of as high as 100 to 1.

Dam and Spillway

3. The first stage of the proposed Kidatu hydroelectric development based on these topographic and hydrologic conditions would involve the construction of a rock-fill dam located 11 km upstream of the Mikumi-Ifakara road bridge, with a maximum height above the river bed of about 37 m and a total crest length of about 350 m. The dam would provide a live storage of some 125 million m^3 at a draw down of 17 m, which in turn would provide a regulated river flow during dry seasons sufficient for the requirements of the first stage of development. On the river's right bank a concrete spillway would be constructed with radial gates capable of passing a discharge of about $7,500 \text{ m}^3/\text{s}$ which is the calculated 10,000 year flood.

Power Plant

4. The water would be conveyed from the reservoir to the turbines through a concrete intake structure, a headrace tunnel, and four vertical penstocks. The intake structure would be located on the right bank of the river just upstream of the dam and would be provided with trash racks and a vertical lift gate. The headrace tunnel would be about 10 km in length and about 10 m in diameter, and since according to geological investigations the rock species in the area is sedimentary gneiss, it would not require lining except possible strengthening in weak zones. At the downstream end of the tunnel a surge gallery would be arranged. Only two of the penstocks would be provided with steel lining and cylindrical gates during the first stage construction and the other two shafts would remain

unfinished behind two simple sliding gates until the construction of the second and third stages of development.

5. Two vertical shaft Francis type turbines which would operate under a maximum net head of about 172 m in an underground station 200 m below ground would be coupled to two generators, each of 50 MW rating. From the turbines water would be discharged (nominally 38 m³/s for each set) to a tailrace tunnel 900 m in length and 80 m² in cross-sectional area. This tunnel would join the river via a short tailrace canal just upstream of the road bridge.

6. In the Kidatu power station, 220 kV 55 MVA step-up transformers, one for each generating set, would be placed underground in separate rooms adjacent to the main machinery hall. Power from the transformers would be carried by 220 kV cables located in a vertical shaft to a pothead arrangement at ground surface, whence it would be transmitted by a short overhead line to an outdoor switch-yard situated near the Kidatu bridge. A single circuit, 306 km 220 kV transmission line would transmit the power to a stepdown substation to be constructed at Ubungo on the outskirts of Dar es Salaam.

Further Stages

7. The second stage of development, planned for commissioning at the beginning of 1980, would involve the addition of a third 50 MW unit at the Kidatu station together with the construction of an earth-fill dam at Mtera located some 175 km upstream of Kidatu. This dam would have a maximum height of about 26 m and a crest length of about 1,900 m. The reservoir formed by this dam would have a live storage of about 3,400 million m³, thus ensuring the availability of water during the driest seasons sufficient for the Kidatu station even after 1983, when a fourth unit of 50 MW would be installed raising the total capacity to 200 MW.

Transmission

8. The 220 kV transmission line from Kidatu to Dar es Salaam would be a single-circuit line on stayed steel towers with steel-reinforced aluminium conductors equivalent in cross-sectional area to 343 mm² copper conductors. Between Dar es Salaam and Morogoro the line would closely follow the route of the Tanzania-Zambia main road, beside which now runs the existing 132 kV transmission line from Hale to Dar es Salaam. Between Morogoro and Kidatu the line would be routed close to secondary roads to facilitate maintenance.

9. The terminal substation at Ubungo would reduce the voltage from 220 kV to 132 kV by means of two 75 MVA auto-transformers, which would feed into the existing 132 kV transmission system. Two other 50 MVA 132/33/11 kV transformers would feed into the 33 kV and 11 kV systems at Ubungo.

Utilization

10. The kWh units to be generated at the Kidatu power plant during 9 years from 1975 to 1983 are shown in the table below. TANESCO's consultants made extensive computer studies for each year included in this table in order to determine the number of units that may be generated at Kidatu power plant to meet the corresponding estimated load* when applying the same water flow conditions in the Great Ruaha River as were prevalent during each separate year of the observed 14 year series 1954 to 1968 which include considerably wet as well as considerably dry conditions. The table shows the mean value of the 14 different annual production figures calculated thus for each of the individual years.

<u>Year</u>	<u>Installed Capacity (MW)</u>	<u>Units Generated (million kWh)</u>	<u>Time of Utilization (hours)</u>
1975	100	358.8	3,590
1976	100	412.8	4,130
1977	100	465.8	4,660
1978	100	519.6	5,200
1979	100	564.8	5,650
1980	150	749.0	4,990
1981	150	843.0	5,620
1982	150	953.8	6,230
1983	200	1,054.0	5,270

11. The amount of generation from Kidatu plant after 1983 will depend on the total system load and the characteristics of other power plants feeding into the system. Calculations have not been extended to include the years after 1983. However, it is estimated that the maximum average annual generation is about 1,300 million kWh.

* Estimated load in these calculations refer to load projections prepared by Merz and McLellan Co. Ltd. of U.K. in 1968. Although these projections have been updated in 1970 for the purposes of this report, the above referred to calculations have not been revised because the differences in the load forecasts as updated were not of great significance as far as these calculations were concerned.

June 24, 1970

TANZANIA

Tanzania Electric Supply Company Limited

COST ESTIMATES OF THE PROJECT

	In Tsh			In US\$			% of Grand Total
	Local	Foreign	Total	Local	Foreign	Total	
-----millions-----							
A. KIDATU POWER STATION							
1. Civil Works							
Dam & Diversion Works	22.0	34.0	56.0	3.08	4.76	7.84	13.27
Power Station, Tunnels & Switch-Yard	20.5	44.5	65.0	2.87	6.23	9.10	15.40
Access Road & Camps	11.0	3.0	14.0	1.54	0.42	1.96	3.32
Contractor's overheads	10.0	23.0	33.0	1.40	3.22	4.62	7.82
Subtotal 1	63.5	104.5	168.0	8.89	14.63	23.52	39.81
2. Mech.&Elec. Equip.							
Gates etc. for dam	0.5	7.0	7.5	0.07	0.98	1.05	1.78
Gates for intake, pen- stock & draft tb	0.7	6.6	7.3	0.10	0.92	1.02	1.73
Turbines	0.7	6.5	7.2	0.10	0.91	1.01	1.71
Generators	0.7	6.1	6.8	0.10	0.85	0.95	1.61
Transf.sw.yd&const.equip	1.2	10.7	11.9	0.16	1.51	1.67	2.83
Aux.mec.&elec.equip.	0.7	6.1	6.8	0.10	0.85	0.95	1.61
Subtotal 2	4.5	43.0	47.5	0.63	6.02	6.65	11.97
Subtotal	68.0	147.5	215.5	9.52	20.65	30.17	51.08
B. TRANSMISSION LINE							
Steel towers & insu- lators	1.0	11.0	12.0	0.14	1.54	1.68	2.84
Foundations	1.5	2.0	3.5	0.21	0.28	0.49	0.83
Conductors & Static wire	0.5	15.5	16.0	0.07	2.17	2.24	3.79
Right of way & clear- ing	2.5	2.5	5.0	0.35	0.35	0.70	1.18
Subtotal B	5.5	31.0	36.5	0.77	4.34	5.11	8.65
C. 15 MW UBUNGO DIESEL							
Building & Foundations	1.0	1.0	2.0	0.14	0.14	0.28	0.47
Diesel Generator	1.0	8.5	9.5	0.14	1.19	1.33	2.25
Electrical Equipment	0.5	2.0	2.5	0.07	0.28	0.35	0.59
Subtotal	2.5	11.5	14.0	0.35	1.61	1.96	3.31
D. ENGINEERING & SUPER- VISION							
	4.0	30.0	34.0	0.56	4.20	4.76	8.06
E. DUTIES & TAXES							
	12.0	-	12.0	1.68	-	1.68	2.84
F. CONTINGENCIES							
	17.0	28.0	45.0	2.38	3.92	6.30	10.66
G. PRICE ESCALATION							
	13.0	52.0	65.0	1.82	7.28	9.10	15.40
GRAND TOTAL	122.0	300.0	422.0	17.08	42.00	59.08	100.00

July 16, 1970

TANZANIA

TANZANIA ELECTRIC SUPPLY COMPANY LIMITED

Schedule of Disbursements

The schedule of disbursements from the proposed Bank loan is expected to be:

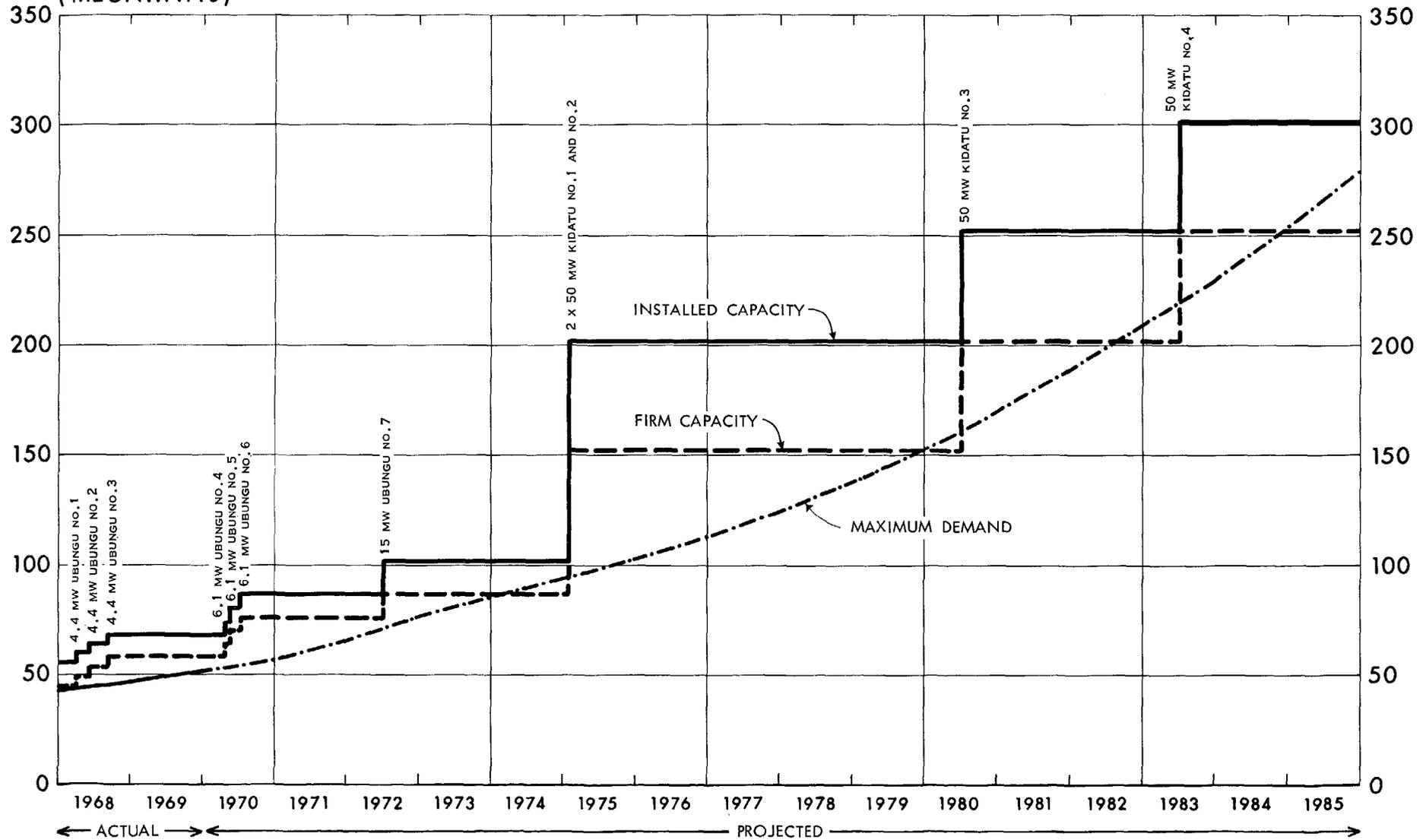
In US\$ (millions)

Years	First Quarter		Second Quarter		Third Quarter		Fourth Quarter	
	Disburse- ment	Balance*	Disburse- ment	Balance*	Disburse- ment	Balance*	Disburse- ment	Balance*
1971	0.50	29.50	0.90	28.60	1.10	27.50	1.31	26.19
1972	1.40	24.79	1.40	23.39	1.50	21.89	1.60	20.29
1973	1.70	18.59	1.80	16.79	2.00	14.79	2.15	12.64
1974	2.30	10.34	2.20	8.14	2.14	6.00	2.11	3.89
1975	0.60	3.29	0.60	2.69	0.50	2.19	0.40	1.79
1976	0.60	1.19	1.19	0.00				

* Undisbursed Loan Balance

September 21, 1970

TANZANIA ELECTRIC SUPPLY COMPANY LIMITED COASTAL SYSTEM CAPACITY AND MAXIMUM DEMAND CURVE (MEGAWATTS)



SEPTEMBER 30 1970

IBRD-4947 (2R)

TANZANIA

Tanzania Electric Supply Company Limited

PAST SALES AND MAXIMUM DEMAND IN COASTAL SYSTEM

1960 - 1969

	<u>1960</u>	<u>1961</u>	<u>1962</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>
<u>Domestic Sales, GWh</u>										
Dar es Salaam	15.25	16.66	19.01	21.18	23.51	26.20	28.90	30.92	33.63	39.28
Morogoro	0.59	0.64	0.71	0.80	0.87	1.03	0.93	0.94	0.98	0.99
Tanga	8.08	7.60	7.86	8.01	8.10	8.24	6.81	5.74	5.30	5.23
Total Domestic	23.92	24.90	27.58	29.99	32.48	35.47	36.64	37.60	39.91	45.50
<u>Commercial Sales, GWh</u>										
Dar es Salaam	8.22	9.98	11.95	13.80	15.64	18.30	20.50	21.50	23.70	28.53
Morogoro	0.46	0.50	0.57	0.55	0.58	0.91	2.18	2.25	2.60	2.64
Tanga	1.11	1.21	1.52	2.38	2.47	2.55	5.95	6.33	6.09	6.65
Total Commercial	9.79	11.69	14.04	16.73	18.69	21.76	28.63	30.08	32.39	37.82
<u>Industrial Sales, GWh</u>										
Dar es Salaam	16.13	18.50	21.58	22.43	27.14	33.81	55.26	75.14	92.20	103.34
Morogoro	0.51	0.56	0.65	0.84	2.82	8.91	10.30	10.87	9.46	10.58
Tanga	37.31	37.75	43.34	47.30	47.85	45.19	44.77	43.05	39.93	44.39
Total Industrial	53.95	56.81	65.57	70.57	77.81	87.91	110.33	129.06	141.59	158.31
<u>Street Lighting, GWh</u>										
Dar es Salaam	0.50	0.54	0.69	0.80	0.89	0.96	1.11	1.18	1.34	1.49
Morogoro	0.06	0.06	0.08	0.08	0.10	0.12	0.13	0.16	0.19	0.21
Tanga	0.23	0.24	0.29	0.30	0.31	0.34	0.35	0.37	0.35	0.36
Total Street Lighting	0.79	0.84	1.06	1.18	1.30	1.42	1.59	1.71	1.88	2.06
<u>Total Sales, GWh</u>										
Dar es Salaam	40.10	45.68	53.23	58.21	67.18	79.27	105.77	128.74	150.87	172.64
Morogoro	1.62	1.76	2.01	2.27	4.37	10.97	13.54	14.22	13.23	14.42
Tanga	46.73	46.80	53.01	57.99	58.73	56.32	57.88	55.49	51.67	56.63
TOTAL SALES COASTAL SYSTEM, GWh	88.45	94.24	108.25	118.47	130.28	146.56	177.19	198.45	215.77	243.69
<u>UNITS GENERATED, GWh</u>	104.39	111.20	127.74	139.79	153.73	172.90	209.08	233.18	248.31	288.23
<u>MAXIMUM DEMAND, MW</u>	21.92	24.85	26.08	27.79	29.43	36.58	41.70	42.84	43.59	50.03

TANZANIA

Tanzania Electric Supply Company Limited

PROJECTION OF SALES AND MAXIMUM DEMAND IN COASTAL SYSTEM

1970 - 1985

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
<u>Domestic Sales, GWh</u>																
Dar es Salaam	43.65	48.50	53.89	59.88	66.54	73.94	82.16	91.30	100.43	110.47	121.52	133.67	147.04	161.74	177.91	195.70
Morogoro	1.05	1.12	1.19	1.26	1.34	1.42	1.51	1.60	1.73	1.87	2.06	2.27	2.50	2.75	3.03	3.33
Tanga	5.49	5.76	6.05	6.35	6.67	7.00	7.35	7.72	8.26	8.84	9.55	10.31	11.23	12.13	13.34	14.67
Total Domestic	50.19	55.38	61.13	67.49	74.55	82.36	91.02	100.62	110.42	121.18	133.13	146.25	160.67	176.62	194.28	213.70
<u>Commercial Sales, GWh</u>																
Dar es Salaam	32.24	36.43	41.17	46.52	52.57	59.40	67.12	75.85	83.44	91.78	100.96	111.07	122.18	134.40	147.84	162.62
Morogoro	2.85	3.08	3.32	3.59	3.88	4.19	4.53	4.89	5.38	5.92	6.51	7.16	7.88	8.67	9.54	10.49
Tanga	6.98	7.33	7.70	8.09	8.49	8.91	9.36	9.83	10.52	11.26	12.16	13.13	14.31	15.60	17.16	18.88
Total Commercial	42.07	46.84	52.19	58.20	64.94	72.50	81.01	90.57	99.34	108.96	119.63	131.36	144.37	158.67	174.54	191.99
<u>Industrial Sales, GWh</u>																
Dar es Salaam	116.77	131.95	146.20	165.58	187.48	212.23	240.20	271.80	307.03	351.36	401.60	463.39	536.56	625.58	735.14	870.65
Morogoro	11.32	12.43	13.28	14.19	15.16	16.20	17.31	18.50	19.98	21.58	23.74	26.11	28.72	31.59	34.75	38.23
Tanga	46.61	55.94	68.39	80.96	93.66	106.49	120.46	135.58	151.66	168.87	187.42	207.56	229.62	253.68	280.85	311.24
Total Industrial	174.70	200.32	227.87	260.73	296.30	334.92	376.97	428.88	490.67	560.81	646.76	748.06	875.90	1015.85	1186.74	1380.12
<u>Street Lighting, GWh</u>																
Dar es Salaam	1.64	1.80	1.98	2.18	2.40	2.64	2.90	3.19	3.51	3.86	4.25	4.66	5.13	5.64	6.20	6.82
Morogoro	0.23	0.25	0.28	0.31	0.34	0.37	0.41	0.45	0.50	0.55	0.61	0.67	0.74	0.81	0.89	0.98
Tanga	0.39	0.42	0.45	0.49	0.53	0.57	0.62	0.67	0.74	0.81	0.89	0.98	1.08	1.19	1.31	1.44
Total Street Lighting	2.26	2.47	2.71	2.98	3.27	3.58	3.93	4.31	4.75	5.22	5.75	6.31	6.95	7.64	8.40	9.24
<u>Total Sales, GWh</u>																
Dar es Salaam	194.0	219.0	273.0	304.0	339.0	378.0	422.5	472.0	528.5	591.5	658.5	733.0	811.0	894.5	987.0	1086.0
Morogoro	15.5	17.0	18.0	19.5	21.0	23.0	24.0	25.5	27.5	30.0	33.0	36.0	40.0	44.0	48.0	53.0
Tanga	59.5	69.5	72.5	76.0	79.5	83.0	87.0	91.0	97.0	105.0	114.0	125.0	137.0	150.5	165.5	182.0
TOTAL SALES TO COASTAL SYSTEM	269.0	305.5	363.5	399.5	439.5	484.0	533.5	588.5	653.0	726.5	805.5	894.0	988.0	1089.0	1200.0	1321.0
<u>UNITS GENERATED, GWh</u>																
	303.0	343.0	408.0	447.0	491.0	541.0	595.0	656.0	727.0	808.0	896.0	995.0	1100.0	1213.0	1338.0	1471.0
<u>MAXIMUM DEMAND, MW</u>																
	56.8	65.6	77.0	85.5	94.0	103.0	113.0	125.0	138.0	151.0	170.0	189.0	209.0	230.0	254.0	279.0

September 22, 1970

TANZANIA

TANZANIA ELECTRIC SUPPLY COMPANY LIMITED

ALTERNATIVE PROJECTIONS OF SALES

IN COASTAL SYSTEM

1. As a check on the TANESCO forecast of energy sales in the coastal system to 1985, three other projections have been made by regression analysis of the relation between past sales and other economic variables. The variables used were monetary GDP, the values of manufacturing output and urban population growth in the three main load centers of Dar es Salaam, Morogoro and Tanga; annual values of these variables were obtained going back to 1960.

2. Statistical analysis ^{1/} showed strong correlations between these variables and electricity sales, as follows:

- (1) Total electricity sales and monetary GDP - correlation: 0.98
- (2) Total electricity sales and all three variables,
correlation: 0.99
- (3) Industrial electricity sales and manufacturing output,
correlation: 0.98
- (4) Domestic and commercial sales and urban population,
correlation: 0.88

The following regression equations were derived:

- (1) Total electricity sales = $-182.9 + 0.111 (\text{GDP})$
- (2) Total electricity sales = $-67.0 + 0.08 (\text{GDP}) + 1.16 (\text{Manufacturing output}) - 0.80 (\text{Urban Population})$
- (3) Industrial electricity sales = $-22.17 + 0.64 (\text{Manufacturing output})$
- (4) Domestic and commercial electricity sales = $-47.5 + 0.326 (\text{Urban Population})$

Projected annual growth rates to 1974, based on the current five year plan, are 7.7% for monetary GDP, 10.7% for manufacturing output and 7% for urban population ^{2/}. It was assumed that these rates would be maintained to 1980

^{1/} The statistical calculations were carried out by Mr. Vito Lara, Statistical Services Division.

^{2/} The GDP and manufacturing output growth rates are as estimated by the 1969 Bank economic mission. The urban population growth rate is based on Government projections.

but would then decline to average rates of 7%, 10% and 6% respectively. On these assumptions, the following three projections of total electricity sales were obtained using the above equations, and adding in the TANESCO projections of street lighting sales, which are a very small proportion of the whole. The TANESCO projections of total sales in the coastal system are shown for comparison:

	<u>Projection 1</u> (Equation (1))	<u>Projection 2</u> (Equation (2))	<u>Projection 3</u> (Equations (3) + (4))	<u>GWh</u> <u>TANESCO Projection</u>
1970	264	257	281	269
1971	298	293	313	306
1972	335	333	350	364
1973	375	378	390	400
1974	418	427	433	440
1975	465	490	478	484
1976	515	560	526	534
1977	568	638	580	589
1978	626	724	638	653
1979	689	820	702	727
1980	756	928	773	806
1981	822	1,035	845	894
1982	893	1,150	923	988
1983	968	1,280	1,010	1,089
1984	1,049	1,423	1,104	1,200
1985	1,135	1,580	1,207	1,321

3. The lowest of the three projections implies an average annual growth rate of 10% and the highest a rate of 12.5%. The TANESCO projection falls in about the middle of this range, with an average growth rate of about 11% per annum.

June 24, 1970

TANZANIA
TANZANIA ELECTRIC SUPPLY COMPANY LIMITED
COMPARISON OF ALTERNATIVE SCHEMES

1. The level of maximum demand and the size of projected annual increases had become so large towards the mid 1960's that it became necessary for TANESCO to plan in terms of larger units of power production for the period 1970 onward. With a view to determining a major energy source to meet the projected requirements, the Company, in 1965, asked their consultants Balfour, Beatty and Co. Ltd. of London, to conduct studies on the Rufiji River and its tributaries and the Wami River, all of which had promising sites for hydroelectric development within reasonable distance from the focal point of the coastal system; and to compare the results with steam alternatives using residual fuel oil from the new refinery at Dar es Salaam. The only other source of fossil fuel available within Tanzania was in a remote area 700 km from the system at the Ruhuhu coalfields in the southern part of the country. This preliminary study resulted in a report, "Power Generation to Meet Demand in 1970-83", dated October 1966, which examined the available data for the 10 sites listed below:

<u>Site</u>	<u>Location</u>
Kijangwe	Wami River
Pongwe	Wami River
Mtera	Great Ruaha River*
Kidatu	Great Ruaha River*
Tavetta	Kilombero River* - Mnyera tributary
Mkasu	Kilombero River* - Ruhuji tributary
Kingenena	Kilombero River* - Ruhuji tributary
Nyangazi	Rufiji River - Luwegu tributary
Shuguri Falls	Rufiji River - Ulanga-Luwegu confluence
Stiegler's Gorge	Rufiji River

* Tributaries of the Rufiji.

2. The Tavetta and Mkasu sites were eliminated from consideration because of their distance from the focal point of the coastal system, the difficulty of access to the sites during the rainy season, the low levels of possible annual power production (150 GWh in both cases), and the very high estimated cost per kWh generated. The Kingenena site, where the possible average production was estimated at about 300 GWh, was eliminated because an appreciable amount of land would be flooded and the Ifakara-Mehenge road would have to be realigned. At the Nyangazi site, geological conditions are likely to be difficult. At the Shuguri site, part of the available head would be included in the Stiegler's Gorge scheme and should therefore be considered only as a stage development of that scheme. The Stiegler's Gorge site was eliminated because of the very high initial investment required for this very important development with about 600 MW firm generation capacity, which is too large in comparison with system requirements for the time period under consideration.

3. Detailed consideration was therefore given to the two alternatives on the Wami River and to the two sites on the Great Ruaha River. According to the investigations undertaken, it was found that Kidatu and Mtera sites on the Great Ruaha River would provide for stage development at lower cost than the Wami alternative.
4. About the same time the Water Development and Irrigation Department of the Government secured the help of the Swedish International Development Authority (SIDA) to finance a comprehensive study of a multi-purpose scheme on the lower part of the Wami River. A Swedish Consulting Group (SWECO) was asked to carry out a preliminary study, whose findings included estimates on the Kidatu/Mtera development for purposes of comparison. The ensuing report, also dated October 1966, concluded that developments on the Wami River would be more advantageous since it provided some irrigation benefits in addition to power.
5. In 1967, Balfour, Beatty & Co. Ltd. made a more detailed appraisal of the Kidatu/Mtera scheme, along with a detailed appraisal of a steam station near the TIPER refinery in Dar es Salaam, using the refinery's residual fuel. Comparison of these alternatives on the basis of discounted cash flow gave an equalizing rate of discount of 7%.
6. The parameters such as interest rates, depreciation, amortization, escalation etc., used by SWECO and Balfour, Beatty in their reports on the two projects, were not the same, so that direct comparison of their conclusions was not possible.
7. The building of new irrigation schemes in the foreseeable future was not recommended by the Bank's 1967 economic mission to Tanzania. Consequently, the mission recommended that a consultant be commissioned to draw up a detailed comparison of the two schemes, Wami and Kidatu, on a basis of power benefits only, and using as far as possible the information contained in the various studies already made. This recommendation was adopted and subsequently put into effect, and it was agreed during negotiations for Loan 518 TA that consultants would be engaged to make an economic comparison of the Kidatu and Wami hydroelectric projects on a strictly comparable basis and to recommend one of the projects for an economic comparison with thermal alternatives, as the next major generating project to be developed in the Coastal Region.
8. This study was jointly prepared by SWECO and Balfour, Beatty at the Government's request in July 1968 under the name of "Comparative Study". It gives the following information on the salient characteristics of the two alternative schemes, together with the characteristics of a comparable thermal generating system:

<u>Ruaha Projects</u>	<u>Total Project Output</u>	<u>Total Cost (millions)</u>	<u>Overall Unit Cost at Dar es Salaam</u>
Stage I Kidatu 100 MW	100 MW & 510 GWh	US\$42	7.83 US mill/kWh
Stage II Kidatu 100 MW	200 MW & 980 GWh	US\$68	5.77 US mill/kWh
<u>Wami Projects</u>			
Stage 1 Pongwe I 60 MW	60 MW & 320 GWh	US\$48	12.51 US mill/kWh
Stage 2 Thermal 60 MW	120 MW & 665 GWh	US\$60.5	9.87 US mill/kWh
Stage 3 Pongwe II 60 MW	180 MW & 1,010 GWh	US\$86.5	8.65 US mill/kWh
Stage 4 Thermal 30 MW	210 MW & 1,010 GWh	US\$92.5	9.27 US mill/kWh
<u>Thermal</u>	210 MW & 1,500 GWh	US\$44	7.84 US mill/kWh

It can be seen that the lower costs and greater output of the Kidatu project make it much more attractive than the Wami project from the point of view of power generation.

9. For the economic comparison of oil fired steam generation with hydro generation, estimates of costs for a comparable size thermal installation were prepared and the cost of steam power compared with that for the Kidatu and Wami projects. These calculations show that the equalizing discount rate for the alternative cost streams is 12% for the Kidatu scheme and the thermal alternative, and 5% for the Wami scheme and the thermal alternative. This indicates that if the opportunity cost of capital is not greater than 12%, the Kidatu project is the most economic of all the alternatives.

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TANZANIA

TANZANIA ELECTRIC SUPPLY COMPANY LIMITED

COMPARISON OF PROJECT WITH ALTERNATIVE THERMAL DEVELOPMENT

1. The thermal alternative to the Project would be a steam station at Dar es Salaam using residual fuel oil from the TIPER refinery. In making the comparison it is not sufficient to compare the Project with an equivalent steam station, since construction of the Project will necessarily involve the subsequent installation of a further 100 MW of hydro capacity to complete the development of the Kidatu site. It is necessary therefore to compare two alternative development programs covering the period up to 1983; the first comprises the Project plus a further 100 MW of hydro capacity constituting Phase II of the Kidatu scheme; the second would consist of 210 MW of steam capacity, to be installed in 30 MW stages in accordance with the projected growth of demand.
2. The hydro development would involve higher capital expenditure but lower running costs than the thermal alternative. The method adopted was to find the rate of discount which equalizes the present values of the capital and operating costs of the two alternative programs over a period of 60 years, which is the estimated life of the hydro scheme. Using the TANESCO load forecast and the consultants' cost estimates, the equalizing discount rate is 13.4%. The hydro capital costs, however, include sunk costs estimated at about Tsh7 million (US\$1 million), which should not enter into the calculation. Allowing for this, the equalizing discount rate rises to 13.8%.
3. This understates the economic return on the extra investment required for the hydro development for two reasons. The first is that the unskilled labor component of costs (which is higher for hydro) is based on money wages rather than the real cost to the economy of this labor as measured by the value of its product in alternative employment. Estimates of this were found to vary from zero to 50% of the money wage, depending on whether the labor was assumed to be otherwise unemployed or to be engaged in the subsistence sector and, in the latter case, on the estimated marginal product of labor in the subsistence sector. The Government department responsible for industry estimates this at 35% of the money wage, while the National Development Corporation, which undertakes industrial projects in the public sector, uses a value of 50% in its project assessments. The higher figure is assumed here.
4. The other reason why the calculated discount rate underestimates the return to the economy is that it does not allow for the additional contribution to national income attributable to the multiplier effect of the extra local expenditure associated with the construction of the hydro scheme compared with a steam station. This depends on the value of the multiplier. No attempt had been made to calculate this in Tanzania but it was suggested to the Bank mission that it was reasonable to assume it would not be very different from the figure of about 2.6 which had been calculated for Kenya. It is conservatively assumed here to be 2. If the hydro

development is credited with the resulting multiplier effects, and if unskilled labor is costed at 50% of the money wage, the equalizing discount rate rises to 16.8%.

5. The sensitivity of the discount rate to changes in the main variables (capital costs, operating costs, load growth) was tested as follows:

Capital Costs

6. It was considered unlikely that the consultants' capital cost estimates for either the hydro or the thermal scheme would be exceeded, since they include adequate allowances for escalation and contingencies, but they could be up to 10% lower in both cases. The effect of reducing them by this percentage is to raise the discount rate by about 0.5 percentage point.

Operating Costs

7. If all costs (other than the cost of residual fuel oil) are assumed to increase by 3% per annum, the discount rate goes up by about 1 percentage point.

Oil Price

8. The consultants assumed a price of Tsh85 per long ton for residual fuel oil from the TIPER refinery to supply the alternative steam station. This compares with the current price paid by TANESCO of about Tsh100 per ton but this is for relatively small quantities of oil of 1,000 seconds viscosity Redwood No. 1, which is actually a blend of about 86% residual and 14% gas oil. The figure of Tsh85 assumes that the steam station would use fuel oil of 3,500 seconds viscosity, which would be cheaper than the present blend, and that the much larger quantity required would be supplied at a lower price. Discussions with TIPER, the oil marketing companies in Tanzania and Shell International in London confirmed that the figure of Tsh85 was a reasonable assumption, and that there would be no difficulty in meeting the requirement (55,000 tons initially, rising to over 300,000 tons by 1983), although TIPER thought that the oil supplied would probably be 2,000-2,500 seconds viscosity. It was suggested that $\pm 10\%$ could be taken as the range of variation about this figure for the medium term. The effect is to raise or lower the equalizing discount rate by about 1 percentage point. For a 20% variation in the price of oil the rate would rise or fall by about 1.5 percentage points.

Load Growth

9. The load growth forecast by TANESCO was used. The alternative projections in Annex 7 suggest a possible range of variation about the TANESCO estimate of $\pm 20\%$. Variations of this order would raise or lower the equalizing discount rate by 0.5 percentage point.

10. The sensitivity analysis carried out indicated that only with an unlikely combination of adverse factors (3% inflation of hydro costs, 10% lower thermal capital cost, 20% lower fuel oil price, no allowance for positive multiplier effects) would the return on the extra investment required for the hydro scheme fall below 10% (to 9.5%). It is unlikely to be less than 12% even if the hydro scheme is not credited with the positive multiplier effects attributed to the extra local expenditure it involves. This is satisfactory since the opportunity cost of capital in Tanzania is believed not to exceed 12%.

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TANZANIA

TANZANIA ELECTRIC SUPPLY COMPANY LIMITED

Incremental Rate of Return

1. The incremental financial rate of return for the Project is defined as the discount rate at which the present worth of the estimated capital and operating costs of the total hydroelectric development (see Annex 3) over its life equals the present worth of revenues attributable to it.
2. Capital costs are assumed to consist of the estimated expenditures for constructing Kidatu and Mtera dams, Kidatu power station, Kidatu-Ubungo transmission line, and 15 MW Ubungo diesel station, and the estimated expenditures required to extend the distribution networks within the coastal system sufficient to absorb the power generated by these additional plants. Yearly capital outlays are included in the cost stream which is extended over 80 years (the life of the civil engineering works). Other installations, except Ubungo diesel plant, are assumed to be reconstructed at the end of 30 years of operation which is taken to be their useful life, and the retirement value of such installations are assumed to be nil. However, the renewals for distribution are not repeated after the first ones since the discount factors become exceedingly small after the 60th year and the effect on the equalizing rate of discount becomes negligible. Plant renewal phasing and costs are assumed to be the same as the original phasing and costs.
3. Operating costs are assumed to consist of estimated increases in annual operation and maintenance expenses (over and above the expenses incurred in 1971, the final year before the 15 MW diesel plant at Ubungo is commissioned), for generation, transmission and distribution and estimated increases in general administration expenses. These expenses are assumed to remain constant from 1986, when the Kidatu station is fully loaded, until the end of the 80-year period under consideration.
4. Annual benefits attributable to the Project are assumed to consist of the increases in the electric revenues of TANESCO from the consumers in the coastal system over and above the revenues realized in 1971, and reaching a ceiling in 1987. The increases in the revenues from this date onwards are assumed to be attributed to succeeding developments in the coastal system. Average revenue to be realized from the Project is assumed to decrease from 19.07 Tcent/kWh in 1972 to 17.50 Tcent/kWh in 1981 due to increase in sales to large consumers who benefit from lower rates associated with large consumption. The average rate is assumed to be constant after 1981.

5. The stream of costs and benefits based on these assumptions is shown in the table below. The discount rate which equalizes the present worths of total costs and benefits is found to be 16%.

6. The above computations are based on the growth of sales shown in Annex 7 which corresponds to about 12% up to 1975 and 10% thereafter. The rate of return computations have been repeated for two other conditions where the growth in sales is taken to be 8% and 12% respectively throughout the range. Calculations have also been made for a 10% reduction in the estimated capital cost of hydroelectric development and operating costs as well as a 30% reduction in the estimated administration expenditures. From all these calculations it was found that the rate of return varies over a range of from 10% to 19% showing more sensitivity to variations in the sales forecasts than to costs.

Years	COSTS			BENEFITS
	Capital Costs			Revenues
	Hydroelectric	Distribution	O & M Expenses	
	Development & Diesel	Extensions	Including Diesel Fuel	
----- Tsh (millions) -----				
1969	3.5	0	0	0
1970	11.5	0	0	0
1971	46.5	0	0	0
1972	81.0	14	2.5	11.5
1973	106.0	15	6.2	18.9
1974	123.5	17	10.5	25.2
1975	30.0	18	8.0	33.2
1976	20.0	20	9.5	41.2
1977	2.5	22	10.9	50.6
1978	32.0	24	12.4	62.4
1979	45.0	26	13.8	74.4
1980	33.0	29	15.4	88.1
1981	45.0	32	16.9	103.3
1982	18.5	35	18.5	119.8
1983	26.5	38	20.2	137.6
1984	0	42	21.8	156.9
1985	3.5	46	22.8	178.0
1986	0	50	24	201
1987-2002	0	0	24	226
2003	0	14	24	226
2004	0	15	24	226
2005	17	17	24	226
2006	0	18	24	226
2007	0	20	24	226
2008	0	22	24	226
2009	0	24	24	226
2010	17	26	24	226
2011	0	29	24	226
2012	0	32	24	226
2013	17	35	24	226
2014	0	38	24	226
2015	0	42	24	226
2016	0	46	24	226
2017	0	50	24	226
2018-2034	0	0	24	226
2035	17	0	24	226
2036-2039	0	0	24	226
2040	17	0	24	226
2041-2042	0	0	24	226
2043	17	0	24	226
2044-2055	0	0	24	226

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TANZANIA
Tanzania Electric Supply Company, Limited
ACTUAL AND ESTIMATED INCOME STATEMENTS 1966-1977
(Thousand Tsh)

Year Ending December 31	Actual				Estimate							
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Units generated (million kWh)	252	282	313	358	399	450	529	585	641	706	796	874
Units sold (million kWh)	215	240	266	307	340	382	452	500	548	603	680	747
Average revenue per kWh (Tcent)	<u>25.32</u>	<u>24.94</u>	<u>24.72</u>	<u>23.65</u>	<u>22.61</u>	<u>22.00</u>	<u>21.02</u>	<u>20.61</u>	<u>20.35</u>	<u>20.07</u>	<u>19.60</u>	<u>19.37</u>
Operating Revenue												
Sale of energy	54,440	59,857	65,762	72,608	76,866	84,038	95,031	103,030	111,535	121,019	133,275	144,683
Other operating revenue	420	1,470	1,657	1,458	1,630	1,830	2,080	2,330	2,580	2,880	3,180	3,480
Total operating revenue	<u>54,860</u>	<u>61,327</u>	<u>67,419</u>	<u>74,066</u>	<u>78,496</u>	<u>85,868</u>	<u>97,111</u>	<u>105,360</u>	<u>114,115</u>	<u>123,899</u>	<u>136,455</u>	<u>148,163</u>
Operating Expenses												
Generation	9,480	10,654	11,121	14,681	14,637	15,080	18,193	20,351	24,235	23,071	23,043	24,875
Transmission and distribution	4,840	6,040	6,272	5,270	5,361	5,646	5,769	6,288	6,639	7,014	7,414	7,846
Administration	8,800	9,650	10,968	11,694	10,754	11,399	12,015	12,821	13,798	15,183	15,297	16,226
Depreciation	9,360	9,046	10,931	12,673	14,278	16,000	17,263	18,406	19,935	26,884	34,702	36,304
Income tax	2,960	6,963	7,589	7,450	7,910	9,776	13,298	15,438	16,150	2,120	2,181	6,887
Amortization of preliminary expenses	20											
Total operating expenses	<u>35,460</u>	<u>42,353</u>	<u>46,881</u>	<u>51,468</u>	<u>52,940</u>	<u>57,901</u>	<u>66,538</u>	<u>73,304</u>	<u>80,757</u>	<u>74,272</u>	<u>82,637</u>	<u>92,138</u>
Operating Income	19,400	18,974	20,538	22,598	25,556	27,967	30,573	32,056	33,358	49,627	53,818	56,025
Other Income	300	491	252	342	320	400	600	500	200		200	800
Total Income Before Interest Charges	<u>19,700</u>	<u>19,465</u>	<u>20,790</u>	<u>22,940</u>	<u>25,876</u>	<u>28,367</u>	<u>31,173</u>	<u>32,556</u>	<u>33,558</u>	<u>49,627</u>	<u>54,018</u>	<u>56,825</u>
Interest Charges												
Less interest charged to construction	4,380	4,880	4,835	5,104	5,733	9,811	12,204	16,160	21,554	25,602	27,604	28,193
		378				3,476	6,423	10,761	16,522	9,912	735	1,715
Interest charged to operations	<u>4,380</u>	<u>4,502</u>	<u>4,835</u>	<u>5,104</u>	<u>5,733</u>	<u>6,335</u>	<u>5,781</u>	<u>5,399</u>	<u>5,032</u>	<u>15,690</u>	<u>26,959</u>	<u>26,478</u>
Net Income	15,320	14,963	15,955	17,836	20,143	22,032	25,392	27,157	28,526	33,937	27,951	30,347
Less Net Income Allocations												
Dividends	7,300	7,305	7,305	7,305	7,839	8,872	10,339	12,306	15,106	16,106	16,390	17,056
Provisions for deferred income taxes				3,483	3,566	3,192	2,433	1,839	1,942	12,592	9,993	8,376
Balance to Surplus	<u>8,020</u>	<u>7,658</u>	<u>8,650</u>	<u>7,048</u>	<u>8,738</u>	<u>9,968</u>	<u>12,620</u>	<u>13,012</u>	<u>11,478</u>	<u>5,239</u>	<u>676</u>	<u>4,915</u>
Rate of return (operating income to average net fixed assets in operation)												
	11.3%	10.8%	10.7%	10.2%	10.1%	10.1%	10.8%	11.3%	11.7%	9.3%	6.9%	7.2%
Times interest charges covered by operating income												
	4.4	4.0	4.2	4.4	4.5	2.9	2.5	2.0	1.5	1.9	1.9	2.0
Operating ratio												
	64.6%	69.0%	69.5%	69.4%	67.4%	67.4%	68.5%	69.6%	70.8%	59.9%	60.6%	62.2%

TANZANIA

Tanzania Electric Supply Company Limited
ACTUAL AND ESTIMATED BALANCE SHEETS 1966-1977

December 31	Actual				Estimate							
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
ASSETS												
Fixed Assets												
Fixed assets in operation	254,043	267,102	306,858	347,789	395,097	423,461	441,561	461,361	482,961	1,001,838	1,038,049	1,065,649
Less accumulated provision for depreciation	81,158	89,413	98,236	111,017	125,295	141,295	158,556	176,264	196,899	223,783	258,485	294,789
Net fixed assets in operation	172,885	177,689	207,922	236,772	269,802	282,166	283,003	284,397	286,062	778,055	779,564	770,860
Work in progress	29,307	47,750	41,447	28,339	25,922	69,827	157,250	271,011	429,033	11,143	17,167	42,882
Total fixed assets	202,192	225,439	249,369	265,111	295,724	351,993	440,253	558,408	715,095	789,198	796,731	813,742
Current Assets												
Cash	10,696	7,011	8,950	5,585	5,089	15,200	19,514	18,969	10,105	500	613	10,115
Inventories	11,481	11,255	11,459	14,070	18,000	20,500	23,000	25,500	28,000	35,000	39,000	43,000
Net Receivables	4,784	6,692	7,459	8,904	8,549	9,457	10,577	11,414	12,292	13,251	14,467	15,586
Prepayments	188	318	110	74	100	100	100	100	100	100	100	100
Marketable securities	198	198	198	198								
Total current assets	27,347	25,504	28,376	28,831	31,926	45,257	53,191	55,983	50,497	48,851	54,210	68,801
Total assets	229,539	250,943	277,745	293,942	327,650	397,250	493,444	614,391	765,592	838,049	850,941	882,543
EQUITY AND LIABILITIES												
Equity												
Ordinary stock	109,573	109,573	109,573	111,086	117,586	133,086	155,086	184,586	226,586	241,586	245,846	255,846
Surplus	1,674	9,331	17,982	1,849	10,387	20,355	32,975	45,987	57,466	81,701	63,380	68,295
Reserves												
General reserve	6,400	6,400	6,400									
Capital reserve	3,140	3,140	3,140	3,140	3,140	3,140	3,140	3,140	3,140	3,140	3,140	3,140
Development reserve	11,800	11,800	11,800	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Currency revaluation		10,120	10,120	10,643	10,643	10,643	10,643	10,643	10,643	10,643	10,643	10,643
Total reserves	21,340	31,460	31,460	33,783	33,783	33,783	33,783	33,783	33,783	33,783	33,783	33,783
Total equity	132,587	150,364	159,015	146,519	161,756	187,224	221,814	264,356	317,834	338,073	343,009	357,924
Long-Term Debt												
C.D.C. Debenture stock 7-1/4%	60,000	51,429	51,429	48,412	45,395	47,378	39,361	36,344	33,327	30,310	27,293	24,276
Government loan (lake shore protective works)		740	740	592	444	296	148					
Hawker Siddeley International limited	9,573	6,564	7,206	4,780	2,711	642	214					
Huston and Hornsby Limited	5,405	3,701	2,780	1,853	926							
Government loan (transmission lines)		3,679	10,334	10,738	13,214	13,214	13,214	13,214	13,214	13,214	13,214	12,333
Government loan (general development-sub-economic projects)		953	893	833	833	773	713	653	593	533	473	413
IBRD Loan No. 518 TA		5,678	17,137	17,137	34,569	35,807	34,415	32,951	31,416	29,774	28,025	26,169
Permanent Housing Finance			193	193	179	164	147	129	110	89	66	41
Proposed Foreign Loans												
IBRD loan (Kidatu Project - Stage I)					27,232	69,358	123,979	186,454	201,448	209,002	203,606	203,606
SIDA loan (Kidatu Project - Stage I)					10,908	27,782	49,661	74,686	80,692	83,675	81,523	81,523
Canadian loan (Hale/Kiculetwa transmission line)								9,000	18,000	18,000	18,000	18,000
Suppliers Credit (Mwanza - set no. 7)					2,500	2,000	1,500	1,000	500		2,000	1,500
Suppliers Credit (Mwanza - set no. 8)									2,500		14,000	28,000
Foreign loan (Kidatu Project - Stage II)											14,000	28,000
Total	75,718	66,119	79,720	84,598	98,271	133,914	187,352	258,431	349,800	377,060	395,748	395,861
Less long-term debt due within one year	2,996	2,996	6,623	6,235	7,556	5,562	5,121	5,131	5,240	13,052	13,887	14,554
Total long-term debt	75,718	63,123	72,497	78,363	90,715	128,352	181,231	253,300	344,560	364,008	381,861	381,307
Current Liabilities												
Sundry creditors and accrued charges	11,595	23,830	28,293	22,596	22,540	27,027	31,830	36,347	39,659	46,100	28,800	35,598
Long-term debt due within one year		2,996	6,623	6,235	7,556	5,562	5,121	5,131	5,240	13,052	13,887	14,554
Bank overdraft										4,725		
Total current liabilities	11,595	26,826	34,916	28,831	30,096	32,589	37,251	41,478	44,899	63,877	42,687	50,152
Contributions in Aid of Construction												
SIDA Grant	9,639	10,630	11,317	11,978	12,678	13,478	14,278	15,078	16,478	17,678	18,978	20,378
				3,189	3,786	3,786	3,786	3,786	3,786	3,786	3,786	3,786
Accumulated Deferred Income Taxes												
			25,063	28,629	31,821	34,254	36,093	38,035	40,627	60,620	68,926	68,926
Total Equity and Liabilities	295,539	250,943	277,745	293,942	327,650	397,250	493,444	614,391	765,592	838,049	850,941	882,543
Debt/Equity Ratio	36/64	31/69	33/67	37/63	38/62	42/58	46/54	49/51	52/48	53/47	54/46	53/47

TANZANIA

Tanzania Electric Supply Company LimitedLong-Term Debt Outstanding at December 31, 1969
(Thousand Tsh)

<u>Description</u>	<u>Date of Loan</u>	<u>Original Principal Amount</u>	<u>Interest Rate %</u>	<u>Amortization Period (Years)</u>	<u>Outstanding at 12/31/69</u>
Debenture Stock Government Loan (Lake Shore Protective Works)	1961	51,429	7-1/4	17	48,412
Supplier Credits: Hawker Siddeley	1966	740	7	5	592
Ruston & Hornsby	1966	10,337	6	5	4,780
Government Loan (Transmission Line)	1966	4,269	5-1/2	5	1,853
Government Loan (Sub-Economic Projects)	1968	13,214	3-1/4	15	10,738
IERD Loan 518-TA	1967	983	-	17	893
Permanent Housing	-	37,128	6	16-1/2	17,137
		200	8-1/2	10	193
Total		<u>118,300</u>			<u>84,598</u>

Tanzania Electric Supply Company Limited

ESTIMATED SOURCES AND APPLICATIONS OF FUNDS STATEMENTS 1970-1977

Year Ending December 31	(Thousand Tsh)							Seven Year	1977
	1970	1971	1972	1973	1974	1975	1976	Summary 1970-1976	
SOURCE OF FUNDS									
Internal Cash Generation									
Operating income	25,556	27,967	30,573	32,056	33,358	49,627	53,818	252,955	56,025
Depreciation	14,278	16,000	17,263	18,406	19,935	26,884	31,702	147,468	36,304
Total internal cash generation	39,834	43,967	47,836	50,462	53,293	76,511	85,520	400,423	92,329
Long-Term Borrowings									
Government loan (Canadian loan)	2,476							2,476	
IBRD Loan No. 518 TA	17,432	2,559						19,991	
Proposed IBRD loan (Kidatu Project - Stage I)		27,232	42,126	54,621	62,475	14,994	12,752	214,200	
Proposed SIDA loan (Kidatu Project - Stage I)		10,908	16,874	21,879	25,025	6,006	4,988	85,680	
Future Canadian loan (Hale/Kikuletwa transmission line)					9,000	9,000		18,000	
Suppliers Credit (Mwanza set no. 7)		2,500						2,500	
Suppliers Credit (Mwanza set no. 8)						2,500		2,500	
Foreign loan (Kidatu Project Stage II)							14,000	14,000	14,000
Total long-term borrowings	19,908	43,199	59,000	76,500	96,500	32,500	31,740	359,347	14,000
SIDA Grant	597							597	
Equity Investments	6,500	15,500	22,000	29,500	42,000	15,000	4,260	134,760	10,000
Miscellaneous Receipts	1,020	1,200	1,500	1,500	1,300	1,200	1,500	9,220	2,200
Total Source of Funds	67,859	103,866	130,336	157,962	193,093	125,211	126,020	904,347	118,529
APPLICATION OF FUNDS									
Construction Expenditures (excluding interest charged to construction)									
IBRD Project (Ubungo and other)	28,724	6,911						35,635	
Kidatu Project - Stage I	12,097	46,500	81,000	106,000	123,500	30,000	20,000	419,097	
Kidatu Project - Stage II							16,000	16,000	24,000
Other construction	4,070	15,382	18,100	19,800	36,600	41,075	25,500	160,527	27,600
Total construction expenditures	44,891	68,793	99,100	125,800	160,100	71,075	61,500	631,259	51,600
Debt Service									
Amortization of long-term debt	6,235	7,556	5,562	5,421	5,131	5,240	13,052	48,197	13,887
Interest	5,733	9,811	12,204	16,160	21,454	25,602	27,694	118,758	28,193
Total debt service	11,968	17,367	17,766	21,581	26,685	30,842	40,746	166,955	42,080
Increase or (Decrease) in Net Working Capital									
Cash	(496)	10,111	4,314	(545)	(8,864)	(9,605)	143	(4,942)	9,472
Inventories	3,930	2,500	2,500	2,500	2,500	7,000	4,000	24,930	4,000
Net receivables	(355)	908	1,120	837	878	959	1,216	5,563	1,119
Prepayments	26							26	
Marketable securities		(198)						(198)	
Increase in sundry creditors and accrued charges	56	(4,487)	(4,803)	(4,517)	(3,312)	13,559	(2,700)	(6,204)	(6,798)
Bank overdraft						(4,725)	4,725		
Total increase in net working capital	3,161	8,334	3,131	(1,725)	(8,798)	7,188	7,384	19,175	7,793
Dividends Paid	7,839	8,872	10,339	12,306	15,106	16,106	16,390	86,958	17,056
Total Application of Funds	67,859	103,866	130,336	157,962	193,093	125,211	126,020	904,347	118,529
Cash balance beginning of year	5,585	5,089	15,200	19,514	18,969	10,105	500		643
Cash increase or (decrease) during year	(496)	10,111	4,314	(545)	(8,864)	(9,605)	143		9,472
Cash balance end of year	5,089	15,200	19,514	18,969	10,105	500	643		10,115
Times annual debt service covered by internal cash generation	3.3	2.5	2.7	2.3	2.0	2.5	2.2		2.2

September 22, 1970

