Folder Title:	Ethiopia - Ethiopian Electric Light and Power Authority [EELPA] - Reports
Folder ID:	30248808
Subseries:	Early special evaluation studies working files
Series:	Special Evaluation Studies
Dates:	04/27/1964 – 04/10/1969
Fonds:	Records of the Office of Operations Evaluation
ISAD Reference Code:	WB IBRD/IDA OPE-09-01
Digitized:	05/16/2023

#375

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Report No. TO-413a

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

INTERNATIONAL DEVELOPMENT ASSOCIATION

THE ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY PROJECT

ETHIOPIA

April 27, 1964

Department of Technical Operations

CURRENCY EQUIVALENT

Eth. $2.5 = U.S. $1

ETHIOPIA

THE ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY PROJECT

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SUMMARY

i. This report covers the appraisal of a project of the Ethiopian Electric Light and Power Authority (EELPA), consisting of the second and third stages of the Awash river hydroelectric development, each with an installed capacity of 32 MW, the expansion of the transmission and distribution facilities of the main EELPA interconnected system, and the provision of about 5.8 MW of diesel generating plant and the expansion of distribution facilities in 18 self-contained systems.

ii. A Bank loan of US$23.5 million equivalent has been requested to cover the foreign exchange cost of the project, the total cost of which is estimated to be the equivalent of US$34.9 million.

iii. The Borrower would be the Ethiopian Electric Light and Power Authority (EELPA), a statutory corporation of the Imperial Ethiopian Government.

iv. The project is technically sound, the estimated cost is reasonable, construction schedules are realistic, and arrangements for construction are satisfactory.

v. The generating capacity and the expansion of transmission and distribution facilities which would be provided by the project are necessary to meet expected demands for power in the interconnected system service area and in the self-contained systems. The proposed installations would be the most economical means of meeting these demands.

vi. The Charter which established the EELPA and which governs its operations is acceptable to the Bank.

vii. The EELPA is well managed and operated, its organization is sound, and it is capable, with the assistance of its Consultants, of constructing the project. It is also capable of operating the project efficiently after it is completed. Assurances have been obtained that competent management will be maintained and that during the life of the loan the Bank will be consulted before appointments, or recommendations for appointments, to the posts of General Manager, Chief Engineer and Financial Comptroller are made.

viii. The financial position of the EELPA is sound and is expected to remain so. Satisfactory arrangements have been made for financing construction expenditures not covered by the proposed Bank loan. A rate covenant and a debt limitation covenant satisfactory to the Bank have been agreed.

ix. The project is suitable for a Bank loan of US$23.5 million equivalent, for a period of 25 years, including a grace period of five years.

ETHIOPIA

THE ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY PROJECT

I. INTRODUCTION

1. This report covers the appraisal of a project of the Ethiopian Electric Light and Power Authority (EELPA), consisting of the second and third stages of the Awash river hydroelectric development, each with an installed capacity of 32 MW, the expansion of the transmission and distribution facilities of the main EELPA interconnected system, and the provision of about 5.8 MW of diesel generating plant and the expansion of distribution facilities in 18 self-contained systems.

2. The estimated cost of the project is Eth.$87.2 million (US$34.9 million). The Bank has been asked to make a loan to cover the foreign exchange cost, including interest during construction, estimated to be equivalent to US$23.5 million.

3. The borrower would be the EELPA, a statutory corporation of the Imperial Ethiopian Government.

4. This report is based on information submitted to the Bank by EELPA, on the findings of a Bank Mission which visited Ethiopia in August 1963, and on the results of significant engineering carried out subsequently.

II. THE BORROWER

5. The Ethiopian Electric Light and Power Authority (EELPA) was established by Imperial Charter on September 11, 1956, as a statutory corporation of the Imperial Ethiopian Government. All the assets and liabilities of the former Government agency responsible for electricity supplies in Ethiopia were transferred to the EELPA in exchange for ordinary stock in the enterprise. The Authority is organized as a modern public utility and functions with a high degree of autonomy with power to establish its own tariffs.

6. The Charter states the purpose of the Authority is "to engage in the business of producing, transmitting, distributing and selling electrical energy to the public in Ethiopia and to carry on any other lawful business incidental or appropriate hereto which is calculated directly or indirectly to promote the interest of the Authority or to enhance the value of its properties."

7. The Authority is responsible for all public electricity supplies in Ethiopia, with one exception, supply to Asmara, the second largest city in the country, which is supplied by an Italian Company which was granted a 44-year concession in 1953.

Organization and Management

8. The Charter provides for a Board of Directors consisting of a Chairman and not more than nine other members to be appointed by the Emperor, on the recommendation of the Minister of Finance. At the present time the Board consists of a Chairman and four other members, who all serve in a part-time capacity.

9. The Charter also provides for the Emperor, on the recommendation of the Board of Directors, to appoint a General Manager who shall be the Chief Executive Officer of the Authority. The present General Manager is a capable Ethiopian engineer and administrator who has held this position for about five years.

10. The Authority is well managed and operated, and its organization, which has been built up over the past seven years, is sound. All senior posts in the Authority, except those of Chief Engineer and Financial Comptroller, are held by Ethiopians. The Board intends to retain the services of the expatriate officers filling these two key positions until such time as local officers with the necessary experience and ability are available. Assurances have been obtained that competent management will be maintained and that during the life of the loan the Bank will be consulted before appointments, or recommendations for appointments, to the posts of General Manager, Chief Engineer and Financial Comptroller are made.

11. On the basis of its past performance the Authority, with the assistance of its Consulting Engineers, is considered capable of carrying out the construction of the project. The Authority is also considered to be capable of operating the project efficiently after it is completed.

Facilities of EELPA

12. The principal generating facilities of the EELPA consist of:

(a) The Koka hydroelectric power station with an installed capacity of 43 MW. This station, which is the first stage of the Awash river development, is situated about 100 kilometers southeast of Addis Ababa, the capital and largest city in Ethiopia. It was completed in 1960.

(b) The Aba Samuel hydroelectric power station with an installed capacity of 6.6 MW. This station is situated on the Akaki river, a tributary of the Awash river, about 35 kilometers south of Addis Ababa. It commenced operations in 1939 with an installed capacity of 3.0 MW, which was increased to 6.6 MW in 1953.

(c) The Ourso hydroelectric power station with an installed capacity of 0.42 MW which is situated near the town of Dire Dawa, some 340 kilometers east of Addis Ababa. It was completed in 1953.

(d) The Addis Ababa thermal power station with an installed capacity of 5.0 MW which was commissioned in 1957. 5.0

(e) The Alemaya diesel power station with an installed capacity of 2.0 MW, which is situated near Dire Dawa, some 340 kilometers east of Addis Ababa. This station was completed in 1958. 2.0

13. All the above stations feed into the main EELPA interconnected system. The Addis Ababa thermal power station, which was closed down after the Koka hydroelectric scheme was commissioned, is now only operated in an emergency as the cost of fuel oil in Addis Ababa is extremely high. The Alemaya diesel power station was taken out of commission in 1961 when the Dire Dawa area became part of the interconnected system. It is now maintained on a stand-by basis.

14. The EELPA has under construction at Tis Abbai on the Blue Nile river, some 350 kilometers north of Addis Ababa, a hydroelectric station which is scheduled to commence operations early in 1964. The initial installed capacity will be 7.7 MW but provision is being made for the installation, at a later date, of an additional generating set to bring the ultimate total of installed capacity to 11.5 MW. The station will supply the town of Bahr Dar, which is situated about 30 kilometers north of Tis Abbai, and a large textile mill which is being constructed near the town. To supply power to the hydroelectric construction site and to give a limited supply to Bahr Dar, 0.8 MW of diesel plant was installed in 1961.

15. The EELPA also operates 15 self-contained systems which are situated in areas remote from the main interconnected system. These systems either have diesel generating plants, small hydroelectric plants or a combination of both. The total installed capacity of diesel plants is 4.46 MW and of hydroelectric plant 0.43 MW. In addition the Authority has three self-contained systems under construction which are scheduled to commence operations early in 1964. Initially these schemes will have 0.33 MW of diesel plant and 0.45 MW of hydroelectric plant installed. A map showing the location of the EELPA's generating stations is attached as an annex.

16. The main EELPA interconnected system extends from Addis Ababa to Harrar, some 350 kilometers east of Addis Ababa. It comprises about 480 kilometers of single circuit transmission lines operating at 132 kV and 45 kV, about 100 kilometers of 15-kV distribution lines, and low voltage distribution systems operating at 380/220 volts which supply some 40,000 consumers.

17. The EELPA also operates a water supply system to supply the small town of Nazareth, which is situated close to the Koka hydroelectric scheme.

III. THE POWER MARKET

18. Sales by the EELPA during the past five years have increased at an average rate of 30% per annum. Total sales during the fiscal year ending September 10, 1963, amounted to 97.13 million kwh. Of this total, about 90 million kwh, or nearly 93%, were sold in the area supplied by the interconnected system. The total number of consumers has risen from 28,427 in 1959 to 49,811 in 1963, an increase of about 75%.

19. The market for power can be broadly divided into four categories - (a) General Sales, (b) Commercial & Industrial Sales, (c) Public Lighting Sales, and (d) Off-Peak Sales. Annex 1 shows the sales for the years 1959-1963, broken down into these categories, for both the interconnected system and the self-contained systems, which may be summarized as follows:

Type of Use	Sales during 1963 Millions of kwh	Percentage of Total Sales	Percentage Increase in 1963 over prev.year	Five-Year Average Annual Percentage Increase
General	40.41	41.6	14.3	18.8
Commercial & Industrial	41.33	42.5	26.0	33.4
Public Lights	2.39	2.5	28.5	21.1
Off-Peak	13.00	13.4	3.8	- 1/
	97.13	100.0	17.7	30.0

20. If reference is made to Annex 1, it will be seen that the increase in sales during 1963 was considerably lower than the increase during 1962, and also lower than the five-year average increase. The decline was not due to any falling-off in demand but was due to the interconnected system distribution facilities being unable to cope with additional loads. The capacity of the distribution systems has already been increased and further expansions are planned which should ensure that this situation will not arise in future.

Forecast of Sales

21. The EELPA's forecast of sales for the years 1964 through 1971 broken down into categories for both the interconnected system and the self-contained systems is shown in Annex 1. These estimates show an average rate of increase per annum in total sales, over the next eight years, of 20%. This may appear high but in view of the present extremely low consumption per capita of about five kwh per annum, and the industrial

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1/ Off-Peak sales commenced in 1961

expansion which is taking place, the estimates are considered realistic and acceptable. EELPA has recently informed the Bank that it considers the estimates may well be on the low side because of a larger increase in the rate of industrial expansion than foreseen earlier.

22. The EELPA estimates general sales in the interconnected system area during 1964 will show an increase of 17.4% over the previous year's sales, and it expects the annual rate of increase to gradually decline to 14.7% by 1971. It also estimates that sales to Commercial & Industrial consumers in the same area will show an average annual increase of 22.7% during the next eight years. Most of the industrial expansion in Ethiopia is taking place in this area and a large number of public buildings and houses are being constructed.

23. General Sales and Industrial & Commercial Sales by the self-contained systems are expected by the EELPA to increase at an average rate per annum of 25.4% and 49.0% respectively over the next eight years. These high rates are chiefly due to the new systems which are scheduled to commence operations during the period. In the circumstances, the rates of increase are not considered unreasonable. The Tis Abbai hydroelectric scheme, with an installed capacity of 7.7 MW, is scheduled to commence operations early in 1964, three systems under construction are scheduled for completion early in 1964, and fifteen new systems are to be constructed during the period under review.

24. Off-Peak power is supplied to industrial consumers in the Addis Ababa area and will be supplied to the textile factory at Bahr Dar from the Tis Abbai hydroelectric station. The amount supplied depends on consumers' demand and the availability of water for hydroelectric generation in excess of normal system requirements. During the next eight years, except for the latter part of 1964, all 1965, and the first five months of 1966, it is expected sufficient surplus water will be available to meet consumers' off-peak requirements. During 1965 and early 1966 all the water available for hydroelectric stations feeding the interconnected system is expected to be required to satisfy system demands and consequently no off-peak power will be supplied in this area. In May 1966 a new hydroelectric station is scheduled to commence operations and off-peak supplies in the Addis Ababa area will then be resumed. No interruption of off-peak supplies from the Tis Abbai hydroelectric station is expected as sufficient water should be available each year to allow the textile factory's requirements to be met.

VIP

Growth in Demand

25. The system maximum demand on the interconnected system has increased from 9.7 MW in 1959 to 25.5 MW in 1963, and is expected to reach 85.0 MW in 1971. The actual increase per annum during 1959-1963 has averaged 30.7% and the average increase per annum forecast to 1971 is 16.3%.

26. A table showing the actual and estimated kwh generated and system maximum demand, based on actual and estimated sales for the years 1959 through 1971, is attached as Annex 2. This table also shows installed and firm generating capacity and the actual and estimated productive capability of hydroelectric and thermal generating stations.

27. The present installed and firm generating capacity and productive capability of the generating stations feeding into the interconnected system are shown in the following table:

	Installed Capacity MW	Firm Capacity MW	Productive Capability of Hydroelectric Stations (Millions of kwh)		Productive Capability of Thermal Stations assuming 80% Annual Availability Millions of kwh
			During year of Average Rainfall	During a Dry Year	
Koka Hydro-electric	43.20	23.00	110	80	-
Aba Samuel Hydro-electric	6.60	4.75	23	18	-
Ourso Hydro-electric	0.42	0.25	2	2	-
Addis Ababa Thermal	5.00	5.00	-	-	35
Alemaya Thermal	2.00	2.00	-	-	14
	57.22	35.00	135	100	49

28. Although the Koka hydroelectric station has three 14.4-MW generating sets, it was designed to have only two sets in operation, the third being kept as spare. With an average water level in the reservoir the firm capacity is 23 MW and the output during a year of average rainfall about 110 million kwh. During a dry year the output falls to about 80 million kwh. The Aba Samuel hydroelectric station has a relatively small reservoir. The Ourso hydroelectric station is a run-of-the-river station. During the dry season of a year the firm capacities of these two stations are 4.75 MW and 0.25 MW respectively.

29. If reference is made to the table in paragraph 27 and to Annex 2 it will be seen that, providing rainfall is average, the hydroelectric stations should be able to meet system demand during most of 1964. By late 1964, during 1965, and the early part of 1966, system demand is expected to exceed the capacity of the hydroelectric stations and it will be necessary to operate the Addis Ababa thermal station. If dry years are encountered additional operation of this thermal station will be required.

New Generating Plant Requirements

30. Two new hydroelectric schemes, Awash II and III, which are part of the project proposed for Bank financing, are scheduled for completion in August 1966 and January 1968 respectively. After Awash III is commissioned sufficient firm hydroelectric capacity and productive capability should be available, even during dry years, to meet system requirements until 1971 when the EELPA plans to have another hydroelectric scheme, Awash IV, in operation.

31. Sales by 15 existing self-contained systems and three new systems under construction are estimated to increase at an average rate of about 30% per annum during the next five years. At the present time the combined installed hydroelectric and diesel generating capacity of the 15 systems is 4.89 MW and the initial combined installed capacity of the three new systems will be 0.78 MW. To cope with increasing demands resulting from the expected rapid increase in sales, the EELPA plans to install about 5.8 MW of additional diesel generating capacity during 1964 through 1968. The provision of this additional plant is part of the proposed Bank project.

IV. HYDROELECTRIC POWER IN ETHIOPIA

32. A survey of the water resources of Ethiopia was carried out by the Government in 1955. The resources, which could be developed economically, were estimated by the survey to have a firm power potential of some 5,226 MW and an annual productive capability of 45,779 million kwh.

33. The majority of the resources are within a radius of 500 kilometers of Addis Ababa, the nearest being those on the Awash river about 100 - 150 kilometers southeast of the city.

34. The total annual productive capability of developments on the Awash river is estimated at 1,287 million kwh. As the load factor of the EELPA interconnected system is about 50%, and is not expected to change substantially in the foreseeable future, the capacity of generating plants which could be installed would be about 300 MW.

35. The first stage of the development of the Awash river is the Koka scheme with a firm capacity of 23 MW and an average yearly output of 110 million kwh which was completed in 1960. The scheme consists of a concrete gravity dam about 42 meters high and 458 meters long which impounds the waters of the Awash river and forms a reservoir with a useful storage capacity of about 1,680 million cubic meters. The power plant consists of three 14.4-MW alternators driven by Francis turbines utilizing an average net head of about 38 meters. The average rainfall in the Awash drainage area above the dam is about 37 inches per annum, about 80% of which occurs during the period between mid-June and mid-September. With an average discharge of 42 cubic meters per second and an average yearly output of 110 million kwh, the capacity of the reservoir is sufficient to give annual regulation.

36. The EELPA now plans to proceed with the construction of Stages II and III of the Awash river development. These schemes will only have small reservoirs as the Koka reservoir will be the main storage reservoir for the whole Awash river development.

37. During 1969, EELPA plans to commence the construction of Stage IV downstream of Awash III. Detailed plans have not yet been finalized but the capacity of this stage will be slightly higher than that of Stage III. The scheme is expected to be in operation by mid-1971.

V. THE PROJECT

38. The project proposed for Bank financing consists of:

(a) Stages II and III of the Awash river hydroelectric development, each with an installed capacity of 32 MW;

(b) The expansion of the transmission and distribution facilities of the main EELPA interconnected system; and

(c) The provision of about 5.8 MW of diesel generating plant and the expansion of distribution facilities in 18 self-contained systems.

Awash II and III Hydroelectric Schemes

39. The two schemes will be located on the Awash river about 125 kilometers southeast of Addis Ababa. The dam for Awash II will be about 25 kilometers downstream of the existing Awash I (Koka) scheme, and the dam for Awash III another 2.3 kilometers downstream. The feasibility of constructing one scheme to give the same output as the Awash II and III schemes has been thoroughly investigated by EELPA's Consultants who found such a scheme to be impracticable because of geological conditions in the area. The most economical way of utilizing the hydroelectric potential of this particular section of the Awash river is to carry out the development in two stages (Awash II and III) and by constructing these two stages as one project, as now planned. Savings in the cost of the main civil works will be obtained by constructing the Awash II and III schemes as one project as they are close together and only one easy diversion of the river will be necessary. A site plan of the schemes is shown in Annex 4.

40. Each scheme will have an installed capacity of 32 MW and an output of about 182 million kwh during a year of average rainfall, and about 135 million kwh during a dry year. Awash II is scheduled for completion in August 1966 and Awash III in January 1968.

41. If 1968 and 1969 are years of average rainfall the output of Awash III may not be required until late 1969 as sufficient other hydroelectric capacity should be available to meet system demand up to this date. If, however, 1968 is a dry year Awash III is then likely to be required by March 1968, soon after it is scheduled for completion. It would be possible to make up for any deficiency in hydroelectric output during dry years by operating the Addis Ababa and Alemaya thermal stations, thus postponing the need for Awash III to be in commission until late 1969. As previously stated these thermal stations are very expensive to operate, and any savings made in interest charges by the postponement of Awash III would be more than offset by the cost of thermal generation.

42. If 1968 and 1969 are dry years, and the completion of Awash III is postponed until December 1969, it is estimated about 80 million kwh would have to be generated by the thermal plants to make up for hydroelectric output deficiency during the period March 1968 to December 1969. The cost of fuel oil and lubricants alone to generate 80 million kwh would be about Eth.$4.4 million, whereas savings in interest charges would only amount to about Eth.$1.25 million.

43. In the circumstances it is considered the construction of Awash II and III as one project is justified as it would be taking too great a risk to postpone the completion of Awash III on the assumption that 1968 and 1969 will be years of average rainfall.

44. The principal features of the two schemes are:

Awash II

(a) A concrete gravity dam about 16 meters high and 100 meters long to create a reservoir with a storage capacity of about six million cubic meters;

(b) A pressure pipeline, about 1,870 meters in length from the reservoir to a surge chamber;

(c) Twin pressure shafts about 160 meters long from the surge chamber to a power station with an installed capacity of 32 MW consisting of two 16-MW units utilizing an average net head of 58.92 meters. The output of the station would be stepped up from 10.5 kV to 132 kV and fed into an adjacent switchyard. The water discharged from the station would flow into the reservoir of the Awash III scheme.

Awash III

(d) A concrete gravity dam about 20 meters high and 130 meters long situated about 300 meters downstream of the Awash II power station, to create a pond with a storage capacity of about 0.8 million cubic meters;

(e) A pressure tunnel, about 1,277 meters in length, from the reservoir to a surge chamber;

(f) Twin pressure shafts about 115 meters long from the surge chamber to a power station with an installed capacity of 32 MW consisting of two 16-MW units utilizing an average net head of 59.94 meters. The output of the station would be stepped up from 10.5 kV to 132 kV and fed into an adjacent switchyard. Tailrace water from the station would discharge into the Awash river;

Transmission

(g) A single-circuit 132-kV transmission line, about two kilometers in length, from Awash III to Awash II. A double-circuit 132-kV transmission line, about 25 kilometers long, from Awash II to Koka. A double-circuit 132-kV transmission line, about 65 kilometers long, from Koka to a new substation at Akaki near Addis Ababa.

45. A more detailed description of the Awash II and III schemes and information on the geological conditions and the hydrology of the area are given in Annex 3.

Status of Engineering

46. The Awash II and III schemes have been planned and are being designed by the EELPA's Consultants, Lahmeyer & Co. of Frankfurt, Germany. The Consultants will supervise the construction of the schemes. Preliminary work on site has been completed and detailed design work and the preparation of tender documents are well advanced. Contracts for construction and the supply and erection of plant and equipment will be awarded on the basis of international competition.

Estimated Cost of the Awash II & III Schemes

47. The total estimated cost of the two schemes and the estimated cost of the principal features are shown in the following table: (A more detailed breakdown of costs is given in Annex 3.)

	Foreign Exchange	Local Costs	Total Costs
	(Eth.$ millions)		
Preliminary works & investigation	-	0.55	0.55
Staff housing	-	1.70	1.70
Civil works	16.65	14.43	31.08
Generating plant	11.69	1.44	13.13
Transmission lines & substations	6.91	1.21	8.12
Engineering & site supervision	0.64	0.38	1.02
Contingencies & price escalation	4.70	2.97	7.67
	40.59	22.68	63.27
Interest during construction	4.05	-	4.05
Totals	44.64	22.68	67.32
Totals expressed in millions of US$	17.8	9.1	26.9

Basis of Cost Estimates

48. In preparing the cost estimates for civil works the Consultants, who have had experience in Ethiopia, were guided by the cost of similar works recently completed or in hand in Ethiopia and neighboring countries and by their knowledge of local working conditions.

49. Prices for generating plant and electrical equipment are based on preliminary quotations from manufacturers.

50. To cover increases in the cost of labor and materials during the construction period, and to provide a margin for unforeseen constructional difficulties, allowances of 19% on civil works and 7% on generating plant and electrical equipment have been included in the estimates.

51. The cost estimates are realistic and should be adequate.

Unit Construction and Generating Costs

52. The total estimated cost of the Awash II and III schemes, excluding interest during construction, is US$25.31 million (Eth.$63.27 million). The total cost of the Consultants' fees is not however included in this estimate as the German Government paid US$0.5 million towards this cost. The adjusted estimated cost of the schemes is therefore US$25.81 million for an installed capacity of 64 MW, which is equal to a unit cost of US$403 per kw installed. In view of the features of the installations this is a reasonable unit cost.

53. During 1969 the estimated output of the two schemes would be 220 million kwh and the cost per kwh generated 2.97 Ethiopian cents (US 11.9 mills). In 1971, with an estimated annual output of 302 million kwh, the cost per kwh generated is estimated at 2.16 Ethiopian cents (US 8.66 mills).

Cost of a Thermal Alternative to the Awash II & III Schemes

54. There are no known fossil fuels in Ethiopia. Fuel oil for the existing thermal plant at Addis Ababa has to be imported through Djibouti in French Somaliland and carried by rail some 735 kilometers. The cost of Boiler "C" fuel oil delivered at Djibouti is Eth.$60 per metric ton (there is no tax on fuel oil) and the cost of rail transportation another Eth.$60 per ton, making a total of Eth.$120 per metric ton (US$48) delivered at Addis Ababa, a very high cost.

55. A thermal plant with an initial installation of one 30-MW generating set would be required at Addis Ababa if the Awash hydroelectric scheme were not constructed. The gross thermal efficiency of such a plant would be about 28%. With the cost of fuel oil at Eth.$120 per metric ton the cost of fuel alone for the plant would be about 3.57 Ethiopian cents (US 14.3 mills) per kwh generated. If this cost is

compared with the estimated cost per kwh generated by the Awash schemes, i.e. 2.97 Ethiopian cents (US 11.9 mills) in 1969 and 2.16 Ethiopian cents (US 8.66 mills) in 1971, it will be seen that an alternative thermal plant need not be considered further.

The Expansion of the Interconnected System

56. To cope with increasing loads on the interconnected system, the EELPA plans, in addition to the transmission lines and substations which are to be installed as part of the Awash II and III schemes, to expand and strengthen transmission and distribution facilities during the period 1964 through 1968.

57. The 132-kV transmission system is to be extended to Sabata and Gafarsa, some 30 kilometers west, and to Cotobie about 25 kilometers east of Addis Ababa. At each of these places new 132/45-kV substations with a total capacity of 36 MVA are to be installed.

58. A 45-kV ring around Addis Ababa is to be completed by the construction of about 76 kilometers of 45-kV transmission line and five new 45/15-kV substations with a total capacity of about 12 MVA. The output of these substations will be fed into the existing 15-kV system. The capacity of existing 45/15-kV substations is to be increased by about 21 MVA and some 400 kilometers of 15-kV lines and underground cables are to be installed.

59. The capacity of 15-kV/380/220-volt substations is to be increased by about 56 MVA and about 350 kilometers of 380/220-volt lines and underground cables are to be installed.

60. The expansions which have been planned by EELPA with assistance from their Consultants, Lahmeyer & Co., are technically sound, are suitable as a basis for further expansion, and should ensure that during the period under review the capacity of the system will be sufficient to meet demands.

Estimated Cost

61. The estimated cost of the expansion program is shown in the following table:

	Foreign Exchange	Local Costs	Total Costs
	(Eth.$ millions)		
Transmission expansion	3.02	0.73	3.75
Distribution expansion	6.74	2.71	9.45
Engineering & supervision	0.16	0.17	0.33
	9.92	3.61	13.53
Totals expressed in millions of US$	4.0	1.4	5.4

Basis of Cost Estimates

62. The cost estimates are based on the cost of similar works recently completed or in hand in Ethiopia. Prices for equipment are based on preliminary quotations from manufacturers. The cost estimates are realistic. Contracts for the supply of plant and equipment and for the erection of transmission lines and major substations will be awarded on the basis of international competition.

Provision of Diesel Generating Plant and the Expansion of Distribution Systems for Self-contained System

63. To meet increasing demands on the 15 existing self-contained systems and expected demands on the three systems under construction, the EELPA plans to install 5.8 MW of diesel generating capacity and to expand and strengthen distribution systems during the period 1964 through 1968.

64. The diesel generating plant to be installed consists of one 1,000-kw set, eleven 300-kw sets and ten 150-kw sets, a total of 22 sets. To expand and strengthen the distribution systems, EELPA plans to construct 132 kilometers of 15-kV overhead line, 104 kilometers of 380/220-volt overhead line, and to increase the capacity of existing 15-kV/380/220-volt substations by 12,600 KVA.

Estimated Cost

65. The estimated cost of the program is shown in the following table:

	Foreign Exchange	Local Costs	Total Costs
	(Eth. $ millions)		
Diesel generating sets	2.15	1.47	3.62
Distribution expansion	1.72	0.69	2.41
	3.87	2.16	6.03
Interest during construction	0.32	-	0.32
	4.19	2.16	6.35
Totals expressed in millions of US$	1.7	0.9	2.6

Basis of Cost Estimates

66. The cost estimates are based on preliminary quotations for generating plant and equipment obtained by EELPA from manufacturers, and on the cost of similar work recently carried out by the Authority. The estimates are realistic. Contracts for the supply and erection of generating plant and the supply of equipment will be awarded on the basis of international competition.

Total Estimated Cost of the Project

67. The total estimated cost of the project including interest during construction, may be summarized as follows:

	Foreign Exchange	Local Costs	Total Costs
	(Eth.$ Millions)		
Awash II & III hydroelectric schemes	44.64	22.68	67.32
Expansion of the interconnected system	9.92	3.61	13.53
Expansion of the self-contained systems	4.19	2.16	6.35
	58.75	28.45	87.20
Totals expressed in millions of US $	23.5	11.4	34.9

Scheduled Completion Dates

68. The first 16 MW generating set at Awash II is scheduled to be in operation in May 1966 and the second set in August 1966. At Awash III, the first 16 MW generating set is scheduled to be in operation in October 1967 and the second set in January 1968. The expansion of the interconnected system and the installation of diesel generating plant and the expansion and distribution facilities in the self-contained systems are scheduled to be completed by September 1968.

VI. FUTURE EXPANSION PROGRAM

69. In addition to the works included in the project being considered for Bank financing, the EELPA has an expansion program covering the period September 11, 1963 to September 10, 1971, estimated to cost Eth.$60.02 million (US $24.0 million). Provision has been made in the financial forecast for this program which may be summarized as follows:

		Estimated Cost Expressed in Millions of Eth.$	US $
(a)	Construction of 15 new self-contained systems, 1965-1971, and provision of additional generating plant and distribution facilities in 18 existing self-contained systems, 1969-1971	13.55	5.42
(b)	Expansion of the interconnected system 1964-1971	13.69	5.47
(c)	Awash IV hydroelectric scheme to be commenced in 1969 and completed mid-1971	28.00	11.20
(d)	Completion of the first stage of Tis Abbai hydroelectric scheme and Bahr Dar distribution system and subsequent expansion	2.34	0.94
(e)	Expansion of the Nazareth water supply system	0.50	0.20
(f)	Miscellaneous expenditures 1964-1971	1.94	0.77
		60.02	24.00

VII. FINANCIAL ASPECTS

Past History

70. The Charter creating the EELPA on September 11, 1956, transferred to the Authority all the assets and liabilities of the former Government Agency and fixed the capital at Eth.$10 million divided into one thousand shares of Eth.$10,000 each. In 1957 the assets were revalued by an independent firm of consultants and the resultant excess of assets over liabilities and capital of Eth.$5 million was credited to capital reserve.

71. During the first three years of its existence, EELPA increased its fixed assets by about 23%, this expansion being financed out of earnings. In 1960 the value of fixed assets was more than trebled by the addition of the Koka hydroelectric plant. This plant, which cost Eth.$34.6 million, was paid for almost entirely out of war reparation payments by Italy. The value of the Koka plant was represented by an addition to capital reserve.

72. The only debt EELPA has contracted comprises suppliers' credits to a total of Eth.$1.7 million. A Yugoslav firm, Ingra, provided Eth.$1.4 million towards the cost of a hydroelectric power plant at Tis Abbai, and English Electric Company supplied a diesel generating set for the plant supplying electricity to Assab port and town. The Ingra credit bears nominal interest at 3% and is repayable over nine years ending in 1972. Interest on the English

Electric credit is included in the cost of the equipment; the credit is repayable in 10 equal semi-annual instalments ending in 1967. The Ingra credit is guaranteed by the Commercial Bank of Ethiopia which holds a mortgage on EELPA's office building in Addis Ababa as security. The insured value of the building is Eth.$2 million--4% of the book value of total assets.

73. Annex 5 gives EELPA's actual and estimated balance sheets for the years ending September 10, 1959 through 1971. Based on the latest information available, the position at September 10, 1963, the end of the Ethiopian fiscal year[1], was as follows:

	Millions of Eth.$
ASSETS	
Fixed assets in operation	58.50
Less: Depreciation reserve	8.38
Net fixed assets in operation	50.12
Work-in-progress	6.99
Current assets*	7.93
Total Assets	65.04
LIABILITIES	
Share capital	10.00[2]
Reserves	50.22
Total equity	60.22
Suppliers' credits	1.73
Consumers' deposits	1.58
Current liabilities	1.51
Total Liabilities	65.04

* Including cash of Eth.$2.2 million

1/ The Ethiopian calendar year starts on September 11, or September 12 in a leap year. The Ethiopian calendar is 8 years behind the Gregorian calendar. Gregorian calendar dates are used throughout this report.

2/ On September 11, 1963 the capital reserve representing the Koka plant was incorporated in share capital thereby increasing it to Eth.$55 million.

Tariffs

74. In 1960 tariffs were reduced by 35% and the tariff structure was simplified. There are now basically only two tariffs, a general tariff and a commercial and industrial tariff. The average household consumer pays 13 Ethiopian cents (5.2 US cents) and the average industrial consumer pays 8 Ethiopian cents (3.2 US cents) per kwh. There is also a special off-peak tariff which varies between 2 and 5 Ethiopian cents (0.8 and 2 US cents) per kwh. These tariffs are relatively high but are competitive with other sources of energy and the Authority does not propose to reduce them.

Taxation

75. Income tax is chargeable on a graduated scale which rises to a maximum rate of 36%, but the tax payable at the highest rates varies in inverse proportion to the paid-up capital. Thus the Authority's recent increase in capital has reduced its income tax liability.

76. The Authority pays municipal taxes except in Addis Ababa where the municipal taxes are deemed to equate street lighting charges for which billings are made but not collected.

Recent Earnings

77. Condensed income statements for the past financial years 1958/59 to 1963 are shown in Annex 6. During this period annual sales increased 183% and gross operating revenues increased 65%. Because of the reduction in tariffs in 1960 and the commissioning of the Koka plant in the same year, the return on average net fixed assets in operation fell from 13.6% in 1958/59 to 6.2% in 1959/60 and to 2.9% in 1960/61. In 1961/62 the return was 5.3% and in 1962/63, 6.6%. Depreciation was charged on the straight-line basis and the rates used, averaging about 3%, were reasonable.

78. The net profit after tax is transferred to capital reserve. This includes a legal reserve to which must be allocated 5% of net profit after tax until the legal reserve amounts to 20% of share capital.

Estimated Future Earnings

79. Estimated income statements for the eight years ending September 10, 1971 are also given in Annex 6. In the estimates:

a) Sales are in accordance with EELPA's estimates (see paragraph 21.) and tariffs have been assumed to remain at present levels. However, an increasing proportion of total sales will be to industrial and commercial consumers, and the average price per kwh is expected to fall from 9.8 to 8.6 Ethiopian cents.

b) Depreciation has been taken at an average of 3% calculated on the straight-line basis.

c) Since tax is computed on the net profit after deducting total interest, interest charged includes interest during construction to be financed by the proposed Bank loan.

80. On the basis of these assumptions the estimated earnings of EELPA show the following results:

a) Net operating revenue, after depreciation but before interest would increase from Eth.$3.3 million in 1962/63 to Eth.$18.4 million in 1970/71. The rate of return on average net fixed assets in operation would increase from 6.6% in 1963 to 9.2% in 1964, then fall to 8.4% because of bringing Awash II into operation. Thereafter it would increase to 12.1% in 1970/71.

b) Coverage of debt service by internal cash generation after deducting income tax would be at its lowest at 2.8 times in 1968/69 when amortization of the proposed Bank loan begins. Coverage would then rise to 3.0 times by 1970/71.

These results would be satisfactory.

81. In accordance with the stated policy of EELPA, it has been assumed that no dividends will be payable in the foreseeable future, but the question will be re-examined by EELPA and the Government near the completion date of the project. It is possible that it may then be decided to pay a reasonable dividend. The Charter of EELPA provides that dividends may be paid "only out of the surplus of net profits remaining after payment of all expenses of operation, segregation of legal and other reserves, allowances for depreciation and amounts necessary for the approved plans of expansion and extension of the business."

Financial Plan

82. A forecast of sources and applications of funds for 1963/64 to 1970/71 is given in Annex 7. The following is a summary of capital requirements and funds available:

	Millions of Eth.$	
	1963/64-1967/68	1968/69-1970/71
Capital Requirements		
Proposed project	81.60	-
Other construction	7.03	53.00
Total construction	88.63	53.00
Debt service	10.76	18.40
Income tax	6.51	10.19
Increase in working capital other than cash	1.50	1.60
	107.40	83.19

	Millions of Eth.$ 1963/64-1967/68	1968/69-1970/71
Sources of Funds		
Internal cash generation	54.28	63.30
Increase in consumers' deposits	.75	.45
Proposed IBRD loan	58.75	-
Future foreign loan	-	35.32
	113.78	99.07
Increase in cash	6.38	15.88

83. The forecast shows that in 1964/65 there will be a cash deficit of Eth.$3.4 million and that the cumulative cash deficit by the end of that fiscal year will be Eth.$2.8 million. However it is estimated that from 1965/66 onwards the Authority's cash income will exceed outgoings and that by 1968 there will be a cash surplus of Eth.$6.4 million. Since the deficit will be temporary it will be met by means of a bank overdraft. The Authority has obtained overdraft facilities of up to Eth.$3 million from the Commercial Bank of Ethiopia against the security of a mortgage on the Authority's buildings in Addis Ababa. The rate of interest on overdrafts is currently 7%.

84. The proposed Bank loan, US $23.5 million, has been taken at 5½% interest and for a term of 25 years including a grace period on amortization payments of five years. The loan includes interest up to September 10, 1966, calculated at Eth.$4.37 million.

85. It has been assumed that the foreign exchange costs of Awash IV amounting to Eth.$35.32 million from 1969 through 1971 will be met from a foreign loan on terms similar to the proposed Bank loan.

86. The financial plan is sound and the following tables show that EELPA will meet a satisfactory percentage of capital requirements from internal cash generation:

		Millions of Eth.$ 1963/64-1967/68		1968/69-1970/71
Construction expenditure		88.63		53.00
Increase in working capital other than cash		1.50		1.60
		90.13		54.60
Internal cash generation		54.28		63.30
Less: Debt service	10.76		18.40	
Income tax	6.51	17.27	10.19	28.59
		37.01		34.71
Financed by net internal cash		41%		64%

Accounting Organization

87. The accounting organization is headed by the Comptroller, a Norwegian accountant who is able and well qualified but in general the rest of the accounting staff lacks experience. The Auditor of EELPA has recently criticized the rapid turnover of personnel and the Authority is taking measures to obtain and retain staff of a good caliber.

Audit

88. Hitherto the audit has been carried out by a qualified English Accountant who held the post of adviser to the Ministry of Finance. Although this arrangement has been satisfactory and the audits have been thorough, it is preferable to have the audit performed by an independent firm of auditors. The Board of EELPA has agreed to appoint a firm acceptable to the Bank.

Financial Covenants

89. Absence of long-term capital in Ethiopia means that EELPA has to finance its expansion entirely out of earnings or foreign borrowings. Thus it is important for the Authority to maintain its net internal cash generation at a high level. While there is little likelihood of EELPA reducing tariffs in the foreseeable future, it is possible that its liquidity will be reduced through increased costs and taxes or through dividend payments. EELPA has agreed to maintain tariffs which will provide revenues sufficient to cover all operating expenses including interest and taxes, repayment of long-term indebtedness to the extent that such exceeds the provision for depreciation and to leave a reasonable surplus to finance the cost of expansion. It has also been agreed that, based on the estimates for the period to 1971, 40% would be a reasonable portion of the cost of expansion to be financed out of revenues.

90. EELPA's present indebtedness is low and the financial plan for the next five years envisages no long-term borrowing other than the proposed IBRD loan. It has been agreed that, unless the Bank shall have given its prior approval, the Authority will not incur any long-term debt prior to the completion of the Bank project, and thereafter not incur any long-term debt unless its net revenue for a 12-month period prior to the incurrence of the debt (adjusted for tariffs in effect at the time of the debt) shall be not less than 1.4 times the maximum debt service requirements in any succeeding fiscal year.

VIII. CONCLUSIONS

91. The project is technically sound, the estimated cost is reasonable, construction schedules are realistic, and arrangements for construction are satisfactory.

92. The generating capacity and the expansion of transmission and distribution facilities provided by the project are necessary to meet expected demand for power in the interconnected service area and in the self-contained systems. The proposed installations would be the most economical means of meeting these demands.

93. The EELPA is well managed and operated, its organization is sound, and it is capable, with the assistance of its Consultants, of constructing the project. The Authority is also considered to be capable of operating the project efficiently after it is completed.

94. The financial position of the EELPA is sound and is expected to remain so. Satisfactory arrangements have been made for financing construction expenditures not covered by the proposed Bank loan.

95. The project is suitable for a Bank loan of US $23.5 million equivalent, for a period of 25 years, including a grace period of five years on amortization payments.

April 27, 1964

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THE ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY

ACTUAL SALES 1959 - 1963
(in Millions of Kwh)

Year	INTERCONNECTED SYSTEM												SELF-CONTAINED SYSTEMS												TOTAL SALES		
	GENERAL			COMMERCIAL & INDUSTRIAL			PUBLIC LIGHTING			OFF-PEAK		SUB-TOTAL			GENERAL			COMMERCIAL & INDUSTRIAL			PUBLIC LIGHTING			OFF-PEAK		SUB-TOTAL				
	Kwh	Percentage Increase Per Annum	Percentage of Total Sales	Kwh	Percentage Increase Per Annum	Percentage of Total Sales	Kwh	Percentage Increase Per Annum	Percentage of Total Sales	Kwh	Percentage of Total Sales	Kwh	Percentage Increase Per Annum	Percentage of Total Sales	Kwh	Percentage Increase Per Annum	Percentage Of Total Sales	Kwh	Percentage Increase Per Annum	Percentage of Total Sales	Kwh	Percentage Increase Per Annum	Percentage of Total Sales	Kwh	Percentage of Total Sales	Kwh	Percentage Increase Per Annum	
ACTUAL																											
1959	18.90	-	55.2	12.97	-	37.9	1.08	-	3.1	-	-	32.95	-	96.2	0.95	-	2.8	0.21	-	0.6	0.15	-	0.4	-	-	1.31	-	3.8	34.26	-	1959
1960	22.69	20.0	52.9	17.17	32.4	40.0	1.18	9.3	2.7	-	-	41.04	24.5	95.6	1.30	36.8	3.0	0.38	80.9	0.9	0.19	26.7	0.5	-	-	1.87	42.7	4.4	42.91	25.2	1960
1961	27.75	22.3	46.7	21.38	24.5	35.9	1.36	15.2	2.3	5.70	9.6	56.19	36.9	94.5	2.47	90.0	4.2	0.56	47.4	0.9	0.25	31.6	0.4	-	-	3.28	75.4 1/	5.5	59.47	38.6	1961
1962	32.02	15.4	38.8	31.08	45.4	37.6	1.54	13.2	1.9	12.53	15.2	77.17	37.3	93.5	3.33	34.8	4.0	1.71	205.3	2.1	0.32	28.0	0.4	-	-	5.36	63.4	6.5	82.53	38.8	1962
1963	35.52	10.9	36.6	39.58	27.3	40.7	1.93	25.3	2.0	13.00	13.4	90.03	16.7	92.7	4.89	46.8	5.0	1.75	2.3	1.8	0.46	43.7	0.5	-	-	7.10	32.5	7.3	97.13	17.7	1963
Average Percentage Increase Per Annum		17.1			32.4			15.7					28.8			52.1			84.0			32.5				53.5			30.0		
Average Percentage of Total Sales			46.0			38.4			2.4		-			94.9			3.8			1.3			0.4				5.5				
ESTIMATED																											
1964	41.7	17.4	33.2	49.3	24.6	39.2	2.2	14.0	1.8	15.0	11.9	108.2	20.2	86.1	6.2	26.8	4.9	5.6	220.0	4.5	0.6	30.4	0.5	5.0	4.0	17.4	145.1 2/	13.9	125.6	29.3	1964
1965	49.1	17.7	34.4	61.1	23.9	42.8	2.6	18.2	1.8	-	-	112.8	4.2	79.0	8.0	29.0	5.6	11.2	100.0	7.9	0.7	16.7	0.5	10.0	7.0	29.9	71.8	21.0	142.7	13.6	1965
1966	57.5	17.1	31.8	76.1	24.5	42.1	2.9	11.5	1.6	10.0	5.6	146.5	29.9	81.1	10.4	30.0	5.8	12.9	15.2	7.1	0.8	14.3	0.5	10.0	5.5	34.1	14.0	18.9	180.6	26.5	1966
1967	67.2	16.9	30.0	94.6	24.3	42.2	3.3	13.8	1.5	20.0	8.9	185.1	26.3	82.6	13.2	26.9	5.9	14.9	15.5	6.6	1.0	25.0	0.4	10.0	4.5	39.1	14.7	17.4	224.2	24.1	1967
1968	77.9	15.9	29.0	116.5	23.1	43.5	3.8	15.1	1.4	25.0	9.4	223.2	20.6	83.3	16.6	25.7	6.2	17.0	14.1	6.4	1.1	10.0	0.4	10.0	3.7	44.7	14.3	16.7	267.9	19.5	1968
1969	89.6	15.0	28.8	142.2	22.1	45.7	4.1	7.9	1.3	25.0	8.1	260.9	16.9	83.9	20.5	23.5	6.6	18.4	8.2	5.9	1.2	9.1	0.4	10.0	3.2	50.1	12.1	16.1	311.0	16.1	1969
1970	102.4	14.3	28.5	171.4	20.5	47.7	4.5	9.7	1.2	25.0	6.9	303.3	16.2	84.3	25.0	21.9	6.9	20.0	8.7	5.6	1.3	8.3	0.4	10.0	2.8	56.3	12.4	15.7	359.6	15.6	1970
1971	117.5	14.7	28.4	203.2	18.5	49.1	4.9	8.9	1.2	25.0	6.0	350.6	15.6	84.7	29.7	18.8	7.2	22.0	10.0	5.3	1.4	7.7	0.3	10.0	2.5	63.1	12.1	15.3	413.7	15.0	1971
Average Percentage Increase Per Annum		16.1			22.7			12.4					18.7			25.4			49.0			15.2					37.1			20.0	
Average Percentage of Total Sales			30.5			44.0			1.5		7.1			83.1			6.1			6.2			0.4			4.2			16.9		

ESTIMATED SALES 1964 - 1971
(in Millions of Kwh)

Fiscal Year - September 11 to September 10

1/ Supply to Bahr Dar commenced in 1961 caused abnormal percentage increases in 1961 and 1962.

2/ Tis Abbai hydroelectric scheme scheduled to commence operations early in 1964.

March 30, 1964

ANNEX 1.

Year	Kwh
ACTUAL	
1959	18.90
1960	22.69
1961	27.75
1962	32.02
1963	35.52
Average Percenta Increase Per Ann	
Average Percenta of Total Sales	
ESTIMATED	
1964	41.7
1965	49.1
1966	57.5
1967	67.2
1968	77.9
1969	89.6
1970	102.4
1971	117.5
Average Percenta Increase Per Ann	
Average Percenta of Total Sales	

Fiscal Year - St

1/ Supply to Ba

2/ Tis Abbai hy

March 30, 1964

ETHIOPIAN ELECTRIC LIGHT & POWER AUTHORITY

INTERCONNECTED SYSTEM

ACTUAL AND ESTIMATED KWH GENERATED AND SOLD. SYSTEM MAXIMUM DEMAND

INSTALLED AND FIRM CAPACITY. ACTUAL AND ESTIMATED PRODUCTIVE CAPABILITY

(Year ending Sept.10) YEARS	kwh Generated (millions)	kwh Sold (millions)	Maximum Demand MW	Annual Load Factor %	GENERATING CAPACITY Installed MW	GENERATING CAPACITY Net Firm MW	PRODUCTIVE CAPABILITY (millions of kwh) HYDRO Average Year	HYDRO Dry Year	THERMAL	TOTAL Average Year	TOTAL Dry Year
ACTUAL											
1959	45.03	32.95	9.7	53.0	17.4	12.0	24	18	49 1/	73	67
1960	51.63	41.04	10.3	57.2	31.8	23.0	77	57	49	126	106
1961	67.52	56.19	19.2	40.1	57.22	35.0	135	100	49	184	149
1962	91.31	77.17	21.9	47.6	57.22	35.0	135	100	49	184	149
1963	107.00	90.03	25.5	47.9	57.22	35.0	135	100	49	184	149
FORECAST											
1964	128.0	108.2	30.0	48.7	57.22	35.0	135	100	49	184	149
1965	133.0	112.8	31.5	48.2	57.22	35.0	135	100	49	184	149
1966	170.5	146.5	36.5	53.3	2/ 89.22	67.0	210	157	49	259	206
1967	215.6	185.1	45.0	54.7	89.22	67.0	317	235	49	366	284
1968	258.5	223.2	54.0	54.6	3/ 121.22	99.0	453	336	49	502	385
1969	300.5	260.9	62.5	54.7	121.22	99.0	499	370	49	548	419
1970	349.4	303.3	73.5	54.3	121.22	99.0	499	370	49	548	419
1971	403.6	350.6	85.0	54.2	4 161.22	139.0	551	408	49	600	457

1/ Assuming 80% annual availability.
2/ Awash II Hydroelectric Scheme . No. 1 & No. 2 - 16.0 MW sets to be commissioned in May 1966 and August 1966 respectively.
3/ Awash III Hydroelectric Scheme. No. 1 & No. 2 - 16.0 MW sets to be commissioned in October 1967 and January 1968 respectively.
4/ Awash IV Hydroelectric Scheme. 40 MW to be commissioned mid-1971.

March 30, 1964

ANNEX 2
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ETHIOPIA

THE ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY PROJECT

DETAILED DESCRIPTION

of the

AWASH II & III HYDROELECTRIC SCHEMES

These schemes, which are the second and third stages of the Awash river development, will utilize the waters discharged from the first stage and a very small amount of water from streams which flow into the Awash river below the Awash I (Koka) dam. The schemes would be located about 125 kilometers southeast of Addis Ababa. The dam of the Awash II scheme would be about 25 kilometers downstream of the Awash I scheme and the dam for the Awash III scheme would be about another 2.3 kilometers downstream. A site plan of the schemes is shown in Annex 4.

The nearest port is Djibouti in French Somaliland, some 735 kilometers by rail from Addis Ababa. A good road runs from Addis Ababa and crosses the Awash river by bridge just above the Awash II dam site. This bridge would be demolished during the construction of the Awash II scheme, and the road would be taken across the river on the top of the Awash II dam. Access roads from this road to major work areas and the staff housing site would be constructed.

As the Awash II & III schemes would be close together the main civil works of both schemes would be constructed simultaneously. This would result in a considerable saving in cost as only one comparatively easy diversion of the Awash river would be necessary.

To divert the river a coffer dam would be constructed just upstream of the Awash II dam site and the river would be diverted into an old river bed by making an opening in the embankment. The diverted waters would then re-enter the existing river bed at a point about 700 meters below the Awash III dam site. The proposed diversion is shown in Annex 4.

Geology

The geology of the area has been thoroughly investigated and is the subject of a special report by the Consultants. Copies of this report have been received by the Bank. An extensive drilling program has been carried out at the proposed dam sites and along the tunnel routes.

Both the Awash II and III dam sites are located in comparatively narrow sections of the river. Bedrock at the Awash II dam site consists

of a series of basalt layers with layers of volcanic ash and tuff in between. At the Awash III dam site bedrock consists of liparitic rock more than 30 meters thick with a layer of impermeable clay beneath. No serious foundation problems are expected.

Due to geological conditions the Awash II pressure tunnel would be constructed in the form of a reinforced concrete pipe in open excavation. The pressure tunnel for Awash III would be mostly in liparitic rock. It would have a continuous concrete lining which would be steel reinforced where fault zones in the rock are intersected.

Hydrology

Regular measurements of the flow in the Awash river above the Awash I dam were commenced in 1943 and have been continued ever since. Readings taken daily show an average yearly water flow into the Awash I reservoir of 1,515 million cubic meters, which corresponds to an average flow of 48.1 cubic meters per second. The period of greatest flow, about 85% of the yearly total, occurs during the rainy season of mid-June to mid-September. The maximum flow observed is 630 cubic meters per second and the minimum about 1.5 cubic meters per second. The probable maximum peak inflow into the reservoir is estimated at 1,400 cubic meters per second.

Precipitation records of the area go back to 1902. The average rainfall in the Awash drainage area above the Awash I dam is about 37 inches, about 80% of which occurs during the rainy season.

The useful storage capacity of the Awash I reservoir is about 1,680 million cubic meters. The annual drop in the reservoir level due to evaporation is estimated at 80 cms. Siltation in the reservoir has been less than expected and the Consultants consider the live storage of the reservoir will have a life of over 100 years.

The Awash I reservoir will be the main storage reservoir for the whole Awash river development. The average discharge from the reservoir is kept by EELPA at 42 cubic meters per second. With this discharge the capacity of the reservoir is sufficient to give yearly regulation.

The spillway capacity of the Awash I dam is 1,400 cubic meters per second with the reservoir water level 2.5 meters below the top of the dam.

Installed Capacity and Energy Output

The Awash II & III schemes are being designed to operate in conjunction with the Awash I scheme to meet present and expected future load conditions in the EELPA interconnected system.

The average discharge from the Awash I scheme is 42 cubic meters per second, and the average flow into the reservoir of the Awash II scheme is estimated at 39.9 cubic meters per second, after allowance is made for an intake from small streams, an offtake for plantation irrigation, evaporation and other losses. The average flow into the reservoir of the Awash III scheme is also estimated at 39.9 cubic meters per second.

The Consultants have investigated the many factors involved to ensure that the available water would be used to the best advantage and have recommended that each of the schemes has an installed capacity of 32 MW. The Consultants' recommendation is considered satisfactory and acceptable. The estimated average annual output of each of the schemes is 182 million kwh.

DESCRIPTION OF PRINCIPAL WORKS

The Awash II Dam

A concrete gravity dam about 16 meters high and 100 meters long would be constructed on the Awash river just downstream of the existing road bridge at Malkasa. This dam would impound the river waters and create a reservoir with a storage capacity of about six million cubic meters. Although the probable maximum peak discharge into the river from the Awash I scheme is estimated to be 1,400 cubic meters per second it is considered the flood would flatten out after discharge and the inflow into the Awash II reservoir is not likely to be more than 800 cubic meters per second. The flood discharge works of the dam, which would consist of eight syphons, a bottom outlet and a spillway, would be designed for a flow of 1,000 cubic meters per second. Although a flood in excess of this amount is considered most improbable there would be a weak part in the embankment of the reservoir which could be breached and used as an emergency spillway, discharging the flood waters into the old river bed.

As the existing road bridge over the river would be submerged by the reservoir waters it would be demolished. The road would be diverted and taken across the river on the top of the dam.

The Awash II Pressure Pipeline

This pipeline would be about 1,870 meters in length and would extend from an intake on the left bank of the reservoir to a surge chamber where it would connect with twin pressure shafts. The pipeline would be of reinforced concrete, of horseshoe cross section with an area of 21.0 square meters, and would be suitable for a maximum flow of 66 cubic meters per second. It would be constructed in an open trench and then covered by back filling. The intake works would consist of a reinforced concrete chamber with control gates and trash racks. The longitudinal slope of the tunnel would differ between 1/100 and 1/1000.

The Awash II Pressure Shafts

Twin steel-lined pressure shafts about 160 meters in length would extend from the junction with the pressure pipeline to the power station. The shafts would have a diameter of 3.4 meters at the upper end reducing to 3.0 meters at the station.

The Awash II Power Station

The power station would be located on the right bank of the Awash river. It would be a reinforced concrete structure with brick panels. The machine hall would house two vertical spindle Francis turbine-driven alternators each of 16.0 MW (20 MVA) nominal output utilizing an average net head of 58.92 meters.

The tailrace waters from the station would be discharged directly into the reservoir of the Awash III scheme.

The Awash III Dam

A concrete gravity dam about 20 meters high and 130 meters long would be constructed on the Awash river about 300 meters downstream of the Awash II power station. This dam would impound the river waters and create a reservoir with a storage capacity of about 0.8 million cubic meters. The flood discharge works of the dam which would be similar to the Awash II works would be designed for a flow of 1,000 cubic meters per second

The Awash III Pressure Tunnel

This tunnel would be about 1,277 meters in length and would extend from an intake on the left bank of the reservoir to a surge chamber where it would connect with twin pressure shafts. It would be of horseshoe cross section, with an area of 21.0 square meters, and would have a continuous concrete lining, steel reinforced where necessary. The intake works would be similar to the Awash II works. The longitudinal slope of the tunnel would be 11.4/1000.

The Awash III Pressure Shafts

Twin steel-lined pressure shafts about 115 meters in length, with a diameter of 3.4 meters at the upper end reducing to 3.0 meters, would extend from the junction with the pressure tunnel to the power station.

The Awash III Power Station

The power station would be located on the left bank of the Awash river. The tailrace waters from the station would be discharged directly into the river. The station would be a reinforced concrete structure with brick panels and would house two vertical spindle Francis turbine-driven alternators, each of 16.0 MW (20 MVA) nominal output utilizing an average net head of 59.94 meters.

Transmission Lines and Substations

The output of the Awash II & III power stations would be stepped-up from 10.5 kV to 132 kV by two 20-MVA transformers at each station, and fed into two adjacent switchyards.

A single-circuit 132-kV transmission line, about two kilometers in length, would be constructed to connect the Awash III switchyard to the Awash II switchyard. A double-circuit 132-kV transmission line, some 25 kilometers in length, would be constructed to connect the Awash II switchyard to the switchyard of the Awash I (Koka) scheme where additional switchgear would be installed.

A new substation with two 20-MVA 132/45/15-kV transformers would be constructed at Akaki near Addis Ababa, which would be connected to the existing transmission system. A double-circuit 132-kV transmission line, about 65 kilometers in length, would be constructed to connect the switch-yard at Awash I to this substation. The existing 132-kV transmission line between Awash I and Addis Ababa would be connected to this sub-station. The output of the three Awash hydroelectric schemes would be fed into the existing Addis Ababa substation and the Akaki substation.

Estimated Cost

A breakdown of the estimated cost of the two schemes is given in the following table:

	Foreign Exchange	Local Costs	Total Costs
		(Eth.$ millions)	
Preliminary works & investigations	-	0.55	0.55
Staff housing	-	1.70	1.70
Sub-total	-	2.25	2.25
CIVIL WORKS			
Awash II			
River diversion & reservoir embankments	0.92	1.45	2.37
Dam and intake	0.96	0.79	1.75
Pressure pipeline	4.11	2.23	6.34
Surge chamber & pressure shafts	0.80	0.54	1.34
Power station & switchyard	1.37	0.92	2.29
Access Roads	0.53	1.24	1.77
Awash III			
Dam and intake	1.18	0.96	2.14
Pressure tunnel	3.21	1.72	4.93
Surge chamber & pressure shafts	0.67	0.44	1.11
Power station & switchyard	1.34	0.90	2.24
Grouting, etc.	0.57	1.32	1.89
Access Roads	0.53	1.24	1.77
Miscellaneous works	0.46	0.68	1.14
Sub-total	16.65	14.43	31.08
ELECTRICAL & MECHANICAL WORKS			
Awash II			
Generating plant	4.24	0.54	4.78
Transformers, switchgear, etc.	1.86	0.21	2.07
Awash III			
Generating plant	4.09	0.52	4.61
Transformers, switchgear, etc.	1.50	0.17	1.67
Akaki Substation	2.48	0.43	2.91
Transmission lines & Koka substation Ext.	4.43	0.78	5.21
Sub-total	18.60	2.65	21.25
Engineering and site supervision	~~0.64~~	~~0.38~~	~~1.02~~
Contingencies	~~3.67~~	~~2.32~~	5.99
Price escalation	~~1.03~~	~~0.65~~	~~1.68~~
Total	40.59	22.68	63.27
Interest during construction	~~4.05~~	-	~~4.05~~
Total	44.64	22.68	67.32
Totals expressed in millions of US$	17.8	9.1	26.9

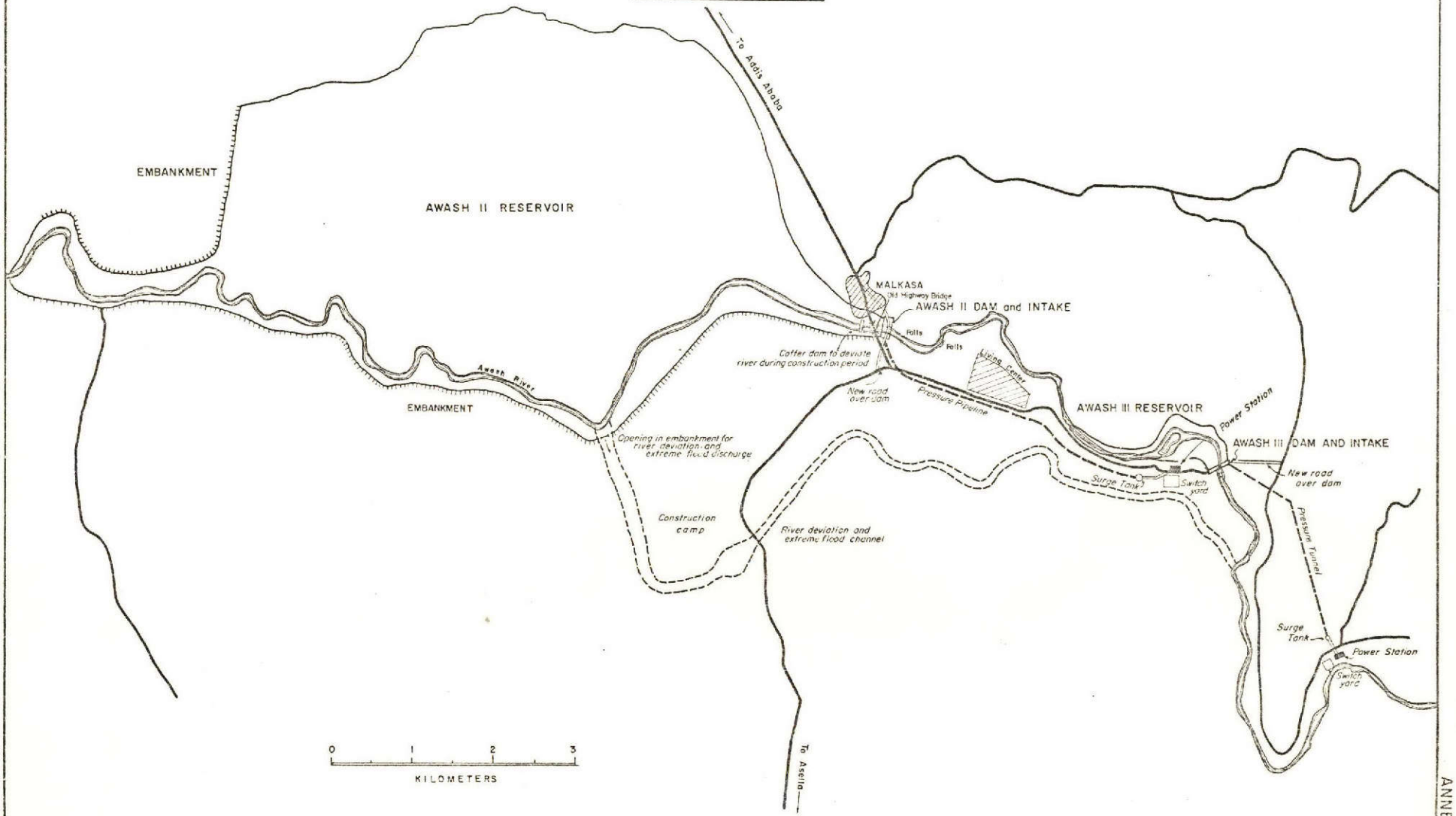
Allowances for contingencies and price escalation included at the following rates:

Civil Works	Electrical & Mechanical Works
Contingencies 15% on foreign & local costs	Contingencies 5% on foreign & local costs
Price escalation 4% on foreign & local costs	Price escalation 2% on foreign & local costs

ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY

AWASH II AND AWASH III HYDROELECTRIC SCHEMES

GENERAL PLAN



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ANNEX 4

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ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY

BALANCE SHEETS
(Millions of Ethiopian $)

As at September 10	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
	ACTUAL					ESTIMATED							
ASSETS													
Fixed assets in operation at valuation or cost[1]	16.55	52.48	54.59	56.77	58.50	70.66	75.30	120.64	125.22	154.12	160.67	171.52	207.12
Less: Depreciation reserve	1.82	2.99	4.80	6.40	8.38	10.57	13.01	16.20	20.14	24.59	29.57	34.81	40.84
Net fixed assets in operation	14.73	49.49	49.79	50.37	50.12	60.09	62.29	104.44	105.08	129.53	131.10	136.71	166.28
Work in progress	1.73	.63	2.56	3.67	6.99	13.19	34.43	10.31	19.35	-	7.25	23.55	-
Current assets	7.31	7.86	6.03	7.46	7.93[2]	8.75	5.54	6.93	9.36	15.81	21.12	23.82	33.29
Total Assets	23.77	57.98	58.38	61.50	65.04	82.03	102.26	121.68	133.79	145.34	159.47	184.08	199.57
LIABILITIES													
Share Capital	10.00	10.00	10.00	10.00	10.00	55.00[3]	55.00	55.00	55.00	55.00	55.00	55.00	55.00
Reserves	10.92	45.34	46.18	47.88	50.22	8.76	11.41	14.70	19.40	25.92	30.96	38.14	46.26
Total equity	20.92	55.34	56.18	57.88	60.22	63.76	66.41	69.70	74.40	80.02	85.96	93.14	101.26
Debt:													
Ingra, Yugoslavia	-	-	-	.69	1.45	1.45	1.40	1.34	1.27	1.03	.77	.51	.25
English Electric	-	-	-	-	.28	.20	.12	.04	-	-	-	-	-
Proposed IBRD loan	-	-	-	-	-	13.01	30.90	46.68	53.36	58.75	57.23	55.61	53.91
Future foreign loan	-	-	-	-	-	-	-	-	-	-	9.20	27.30	35.32
Total debt	-	-	-	.69	1.73	14.66	32.42	48.06	54.63	59.78	67.20	83.42	89.48
Consumers' deposits	.87	1.04	1.21	1.43	1.58	1.73	1.88	2.03	2.18	2.33	2.48	2.63	2.78
Current liabilities	1.98	1.60	.99	1.50	1.51	1.88	1.55	1.89	2.58	3.21	3.83	4.89	6.05
Total Liabilities	23.77	57.98	58.38	61.50	65.04	82.03	102.26	121.68	133.79	145.34	159.47	184.08	199.57
Debt/Equity ratio	0/100	0/100	0/100	1/99	3/97	19/81	33/67	41/59	42/58	43/57	44/56	47/53	47/53

1/ Fixed assets were revalued in 1957 by an independent firm of consultants. Subsequent additions are shown at cost
2/ Including cash of Eth.$2.2 million
3/ Increase in capital effective 11 September 1963

NOTE: The results for 1963 are provisional and are based on the latest information available.

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ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY

INCOME STATEMENT

Years ending September 10	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
	ACTUAL					ESTIMATED							
ENERGY SALES													
Millions of kwh sold	34.3	42.9	59.5	82.5	97.1	125.6	142.7	180.6	224.2	267.9	311.0	359.6	413.7
Average price per kwh in Eth. cents	16.74	14.61	10.29	9.85	9.78	9.39	9.39	9.14	9.01	8.88	8.84	8.76	8.65
	(Millions of Ethiopian Dollars)												
REVENUE ACCOUNT													
Operating Revenues	5.74	6.27	6.12	8.13	9.50	11.80	13.40	16.50	20.20	23.80	27.50	31.50	35.80
Operating, Administration and maintenance expenses	2.06	2.24	2.56	3.11	3.70	3.95	4.11	4.92	5.42	6.22	7.40	8.00	8.60
Fuel and lubricants	.96	.56	.30	.40	.59	.60	1.40	1.35	1.50	1.95	2.20	2.50	2.80
Depreciation	.78	1.47	1.80	1.96	1.99	2.19	2.44	3.19	3.94	4.45	4.98	5.24	6.03
Total expenses	3.80	4.27	4.66	5.47	6.19	6.74	7.95	9.46	10.86	12.62	14.58	15.74	17.43
Net Operating revenue	1.94	2.00	1.46	2.66	3.31	5.06	5.45	7.04	9.34	11.18	12.92	15.76	18.37
Total interest	-	-	-	.01	.03	.22	1.83	2.44	2.64	2.93	3.73	4.27	4.78
Net profit before tax	1.94	2.00	1.46	2.65	3.28	4.84	3.62	4.60	6.70	8.25	9.19	11.49	13.59
Income tax on profits for year	.57	.58	.48	.89	.93	1.30	.97	1.31	2.00	2.63	3.25	4.31	5.47
Net profit[1/]	1.37	1.42	.98	1.76	2.35	3.54	2.65	3.29	4.70	5.62	5.94	7.18	8.12
Return on average net fixed assets in operation	13.6%	6.2%	2.9%	5.3%	6.6%	9.2%	8.9%	8.4%	8.9%	9.5%	9.9%	11.8%	12.1%

1/ Before transfer of 5% of net profit after tax to legal reserve. The legal reserve is included in total reserves in the Balance Sheets.

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ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY

SOURCES AND APPLICATIONS OF FUNDS
(Millions of Ethiopian $)

Years ending September 10	1964	1965	1966	1967	1968	Total 1964-1968	1969	1970	1971	Total 1964-1971
SOURCES OF FUNDS										
Internal Cash Generation:										
Net operating revenue	5.06	5.45	7.04	9.34	11.18	38.07	12.92	15.76	18.37	85.12
Depreciation	2.19	2.44	3.19	3.94	4.45	16.21	4.98	5.24	6.03	32.46
Total	7.25	7.89	10.23	13.28	15.63	54.28	17.90	21.00	24.40	117.58
Increase in consumers' deposits	.15	.15	.15	.15	.15	.75	.15	.15	.15	1.20
Borrowings:										
Proposed IBRD loan	13.01	17.89	15.78	6.68	5.39	58.75	-	-	-	58.75
Future Foreign loan	-	-	-	-	-	-	9.20	18.10	8.02	35.32
Total	13.01	17.89	15.78	6.68	5.39	58.75	9.20	18.10	8.02	94.07
TOTAL SOURCES	20.41	25.93	26.16	20.11	21.17	113.78	27.25	39.25	32.57	212.85
APPLICATIONS OF FUNDS										
Construction expenditure (excluding interest):										
Proposed IBRD project[1]	16.88	24.28	20.44	11.73	8.27	81.60	-	-	-	81.60
Other	1.48	1.60	.78	1.89	1.28	7.03	13.80	27.15	12.05	60.03
Total Construction Expenditure	18.36	25.88	21.22	13.62	9.55	88.63	13.80	27.15	12.05	141.63
Debt Service:										
Interest - Ingra, Yugoslavia	.04	.04	.04	.04	.04	.20	.03	.02	.01	.26
- Proposed IBRD loan	.18	1.79	2.40	2.60	2.89	9.86	3.22	3.12	3.04	19.24
- Future Foreign loan	-	-	-	-	-	-	.48	1.13	1.73	3.34
Total interest	.22	1.83	2.44	2.64	2.93	10.06	3.73	4.27	4.78	22.84
Amortization - Ingra, Yugoslavia	-	.05	.06	.07	.24	.42	.26	.26	.26	1.20
- English Electric	.08	.08	.08	.04	-	.28	-	-	-	.28
- Proposed IBRD loan	-	-	-	-	-	-	1.52	1.62	1.70	4.84
Total amortization	.08	.13	.14	.11	.24	.70	1.78	1.88	1.96	6.32
Total Debt Service	.30	1.96	2.58	2.75	3.17	10.76	5.51	6.15	6.74	29.16
Income tax payable	.93	1.30	.97	1.31	2.00	6.51	2.63	3.25	4.31	16.70
Increase in working capital other than cash	.20	.20	.30	.40	.40	1.50	.50	.50	.60	3.10
TOTAL APPLICATIONS	19.79	29.34	25.07	18.08	15.12	107.40	22.44	37.05	23.70	190.59
Cash Surplus or (Deficit)	.62	(3.41)	1.09	2.03	6.05	6.38	4.81	2.20	8.87	22.26
Cumulative Cash Surplus or (Deficit)[2]	.62	(2.79)	(1.70)	.33	6.38		11.19	13.39	22.26	
Times debt service covered by internal cash after tax		3.4	3.6	4.3	4.3		2.8	2.9	3.0	

1/ Does not include Eth.$1.23 million incurred prior to 1964
2/ Does not include the opening cash balance of Eth.$2.20 million which is required for working capital

April 27, 1964

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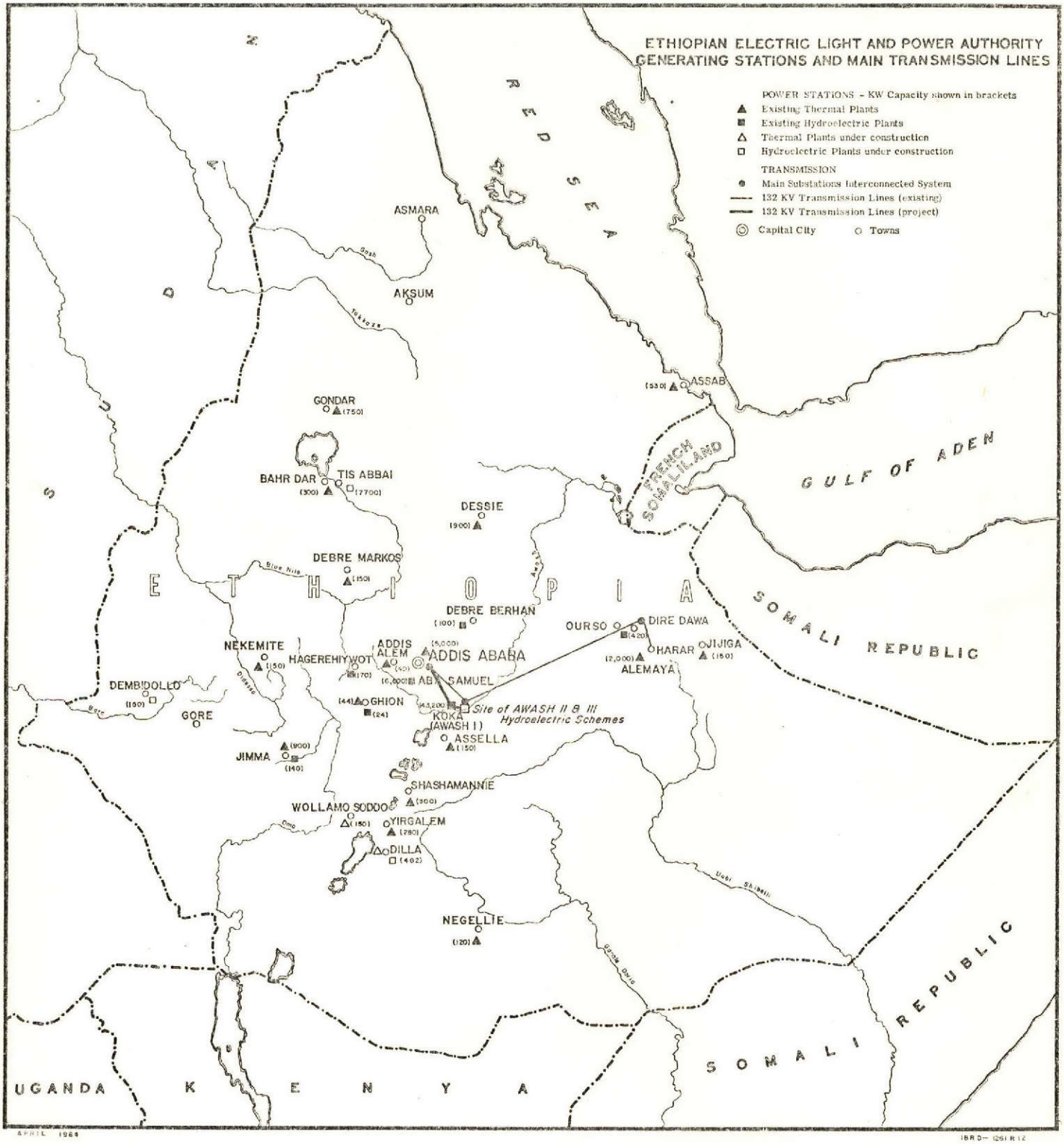

APRIL 1968

IBRD- 1261 R 12

RESTRICTED

Report No. PU-9a

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

INTERNATIONAL DEVELOPMENT ASSOCIATION

ETHIOPIA

APPRAISAL OF THE FINCHAA HYDROELECTRIC PROJECT

OF THE

ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY

April 10, 1969

Public Utilities Projects Department

CURRENCY EQUIVALENTS

US$ 1	=	Eth$2.50
Eth$ 1	=	US$0.40
Eth$ 1 million	=	US$400,000

Fiscal year ends September 10th

MEASURES AND EQUIVALENTS

kw	- kilowatt	=	1,000 watts
MW	- megawatt	=	1,000 kilowatts
kwh	- kilowatt hour	=	1,000 watt hours
kv	- kilovolt	=	1,000 volts
km	- kilometer	=	0.6214 miles
m	- meter	=	3.28 feet
m^3	- cubic meter	=	35.3 cubic feet
hm^3	- million cubic meters	=	35.3 million cubic feet

ABBREVIATIONS AND ACRONYMS

AID -Agency for International Development
EDF -Electricite de France
EELPA -Ethiopian Electric Light and Power Authority

ETHIOPIA

APPRAISAL OF THE FINCHAA HYDROELECTRIC PROJECT

THE ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY

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This report was prepared by Donald King and Maurice J. Reis

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THE ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY

SUMMARY

i. This report covers the appraisal of a project of the Ethiopian Electric Light and Power Authority (EELPA) consisting of the construction of the 100 MW Finchaa hydroelectric plant and associated transmission in Ethiopia. The project is estimated to cost a total of US$33.8 million equivalent and the proposed loan would cover the foreign exchange cost amounting to US$23.1 million equivalent, including interest during construction. The project represents the major portion of the overall expansion program of EELPA, the total cost of which is estimated at about US$49 million during the project construction period 1969-73 inclusive.

ii. The project was to have been financed by an AID loan but when it appeared in October 1968 that the cost would be substantially higher because of the lack of international bidding the Ethiopian Government requested the Bank to finance it instead.

iii. The borrower would be EELPA, a statutory corporation of the Ethiopian Government. One previous loan for power, No. 375-ET for US$23.5 million, was made to EELPA in 1964 for the construction of the Awash II and Awash III hydroelectric stations and associated transmission and distribution. While commissioning of the Awash III station has been delayed two years because of construction difficulties, experience with the loan has otherwise been satisfactory and EELPA is deemed to be a suitable borrower. Since its formation in 1955 it has developed into an efficient utility and has made good progress in developing its organization.

iv. The project is technically sound, the estimated cost is reasonable and the arrangements for engineering, procurement and construction are satisfactory. The facilities to be provided are necessary to enable EELPA to meet the expected demands for power. The financing arrangements are satisfactory.

v. The project would be suitable for a Bank loan of US$23.1 million equivalent for 25 years including a grace period of five years.

ETHIOPIA

APPRAISAL OF THE FINCHAA HYDROELECTRIC PROJECT

THE ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY

I. INTRODUCTION

1.01 This report covers the appraisal of a project of the Ethiopian Electric Light and Power Authority (EELPA), consisting of the 100 MW Finchaa hydroelectric development and the associated 215 km, 220 kv transmission line and terminal substation. The Bank has been asked to make a loan of US$23.1 million to cover the estimated foreign exchange cost, including interest during construction. The proposed loan would represent 68% of the total cost of the project, estimated at US$33.8 million equivalent, and 50% of the total cost of EELPA's expansion program during the 1969-73 project construction period. The Borrower would be EELPA, a statutory corporation of the Ethiopian Government.

1.02 The Ethiopian Government had made a loan agreement with AID for the construction of Finchaa and about US$700,000 was actually disbursed for consulting services. However, when bids were received from United States contractors for the civil works, EELPA and its consultants deemed them to be too high. Representations were then made to AID to enlarge the scope of the bidding to include foreign as well as U.S. contractors but this was not found possible under the provisions of AID assistance. The Ethiopian Government and EELPA were not prepared to pay the extra cost which they considered would result from lack of international competition, AID having indicated that it would not be able to increase the amount of the loan to cover the increased costs. Accordingly, in October 1968, the Ethiopian Government and EELPA requested the Bank to finance the project. However, AID has agreed to continue to finance consulting services until the proposed Bank loan is signed, additional AID disbursements of US$400,000 being estimated in this connection, up to a maximum cumulative amount of US$1,200,000. The remainder of the AID Loan would then be cancelled, repayment of the amount actually lent commencing in 1975 in accordance with the provisions of the agreements.

1.03 This is the second loan to EELPA, Loan 375-ET having been made in 1964 for an amount of US$23.5 million to finance the construction of the Awash II and Awash III hydroelectric plants and associated transmission and distribution facilities. The Awash II plant has been in service since 1967 and is operating successfully. However, when Awash III was about to be placed in service in February 1968 damage occurred to the pressure tunnel when it was filled with water and the plant was shut down. An investigation determined that the failure was due to a combination of factors including poor design and construction. It appears that the consultants and contractor are at least partially to blame. It is expected that the repairs for which some contracts have been let will cost about US$700,000 equivalent which will be financed from the remaining funds in Loan 375-ET, resulting in its full disbursement. The plant should be placed in service during the first half of 1970. It has been necessary to postpone the Closing Date of Loan 375-ET accordingly. Other than the difficulties with Awash III, the performance of EELPA has been satisfactory under Loan 375-ET.

1.04 The appraisal and this report were made by Messrs. D. King and M. J. Reis.

II. THE ELECTRIC POWER SECTOR

2.01 Ethiopia has a population of about 23 million and an area of 450,000 square miles. The population is widely distributed and the largest urban center is the capital, Addis Ababa, with a population of about 700,000. The country is predominantly agrarian, agriculture accounting for about two-thirds of the Gross Domestic Product (GDP). Population is increasing at the rate of about 2% annually and GDP increased at an average annual rate of about 4.3% in the first five years of the 1960-70 decade.

2.02 While manufacturing, small scale industry, construction and trade represent the minor part of the GDP, as distinct from agriculture and public services, they achieved a high rate of growth in the period, outstripping that of the agriculture sector. As a result, the growth of electricity use has been substantial and, moreover, at least half of the amount consumed is for industrial and commercial purposes.

2.03 Government policy in the power sector is to extend service to the larger population and administrative centers as capital and other considerations permit. There are now about 35 centers with a total population of about 1.5 million people served by EELPA. In addition in the province of Eritrea adjoining the Red Sea electricity service is provided by an Italian investor owned utility to Asmara, the second largest city in Ethiopia, and to Massawa. The prospect is that electricity supply will be confined to population centers for considerable time to come; there is no significant rural distribution and given the dispersed nature of the agricultural community and its low monetary income the prospect of any rural electrification in the foreseeable future is unlikely.

The Borrower

2.04 EELPA was established by Imperial Charter in 1955 as a statutory corporation of the Ethiopian Government which is the sole owner thereof. The authority is well organized and functions with a high degree of autonomy. It is responsible for public electricity supplies in Ethiopia with the exception of the enterprise referred to in paragraph 2.03 and a few thermal plants owned and operated by industries to supply their own needs. Responsibility for EELPA's operations are vested in a Board of Directors consisting of a Chairman and not more than nine other members appointed on the recommendation of the Minister of Finance. At present there are six directors, predominantly from the field of Government enterprise and public affairs, all of whom are experienced in administration and finance.

2.05 The General Manager is appointed by the Government on the recommendation of the Board. The present General Manager, appointed to the post in February 7, 1969 is an experienced engineer and administrator who has been with EELPA for 13 years. His predecessor, who directed EELPA for 16 years, was appointed to the cabinet.

2.06 The authority is reasonably well managed, operated and organized. Over the course of time Ethiopians have replaced foreigners in the senior positions and for several years the only senior post held by a foreigner has been that of financial comptroller. Loan 375-ET provides that the Bank will be consulted before appointments to the posts of General Manager, Chief

Engineer and Financial Comptroller are made. The Government and EELPA have agreed to continue to consult on new appointments to these posts. EELPA has approximately 1,700 employees exclusive of temporary labor hired for construction purposes. Approximately 1,000 are engaged in operations, 200 in accounting, and 500 in clerical and administrative work. Some 35 engineers are responsible for engineering and supervision of operations. The design/engineering of large projects is entrusted to consulting engineers.

2.07 EELPA has a training school for operators and maintenance men, operated by foreign personnel under the auspices of Electricite de France (EDF) under French Government assistance. EELPA sends some of its more promising employees to the Haile Selassie University in Addis Ababa for engineering training. In addition it is planning to send some employees abroad for post graduate technical training and the proposed loan includes an amount of $100,000 for this purpose. EELPA has retained the services of EDF to review the administrative practices of the organization. While the Accounting Department is well administered it continues to have the problem of staff leaving for better paid positions, leading to insufficient middle level staff. EELPA is making efforts to improve this situation.

2.08 The number of employees, of which there are 55 per thousand consumers, the training programs and the organizational structure are appropriate to the services EELPA provides, and operating costs are reasonable. Power system losses amount to 14% including station auxiliary services, which is reasonable. EELPA should be able to satisfactorily undertake the construction of the proposed project with the assistance of its new consultants, Harza Engineering Co., and operate it satisfactorily thereafter.

Facilities of the Borrower

2.09 EELPA's main electricity facilities are interconnected and the interconnected system, shown on the map, accounts for about 85% of sales. In addition EELPA serves some 23 communities by isolated or self-contained power systems, each such system having its own thermal or hydroelectric plant and distribution system. Annex 1 lists the generating facilities of the interconnected and self-contained systems, the former having an aggregate generating capacity of about 126,000 kw and the latter of about 26,000 kw. The main generating stations which supply the interconnected system are located on the Awash River. While some storage capacity is provided, the generating stations are subject to a substantial reduction in capacity during dry years. The Finchaa generating station, the object of the proposed loan, will be located on another river, with adequate storage. Integration of its operation with existing generation stations would improve the overall system characteristics.

2.10 In 1967 the high voltage transmission system comprised 560 km of transmission circuit operating at 132 kv. There were approximately 1,000 km of primary distribution circuit and 2,200 km of low voltage lines. Distribution transformer capacity totalled approximately 120,000 kva. Secondary distribution is almost entirely of overhead construction.

Future Expansion Program

2.11 In addition to the proposed project EELPA has planned a program of expansion during the 1969-73 project period estimated to cost US$15 million equivalent approximately. This would provide for expansion of the distribution systems and for the establishment of self-contained systems at 17 new communities, involving installations aggregating about 9,000 kw of hydroelectric and diesel electric generating capacity.

2.12 This program is contingent on further study and review, the availability of capital and the priorities established by the Government. As noted in paragraph 2.03, the Government decides on the provision of electricity supply to communities on the basis of their size and importance. The program, therefore, is flexible and should less capital than foreseen be available to EELPA it would be reduced, or phased out over a longer period.

2.13 Given that thermal power is very expensive (para. 4.11), EELPA would likely start the construction of a new hydroelectric facility in 1974 to have additional power available about 1977/78 when the full output of Finchaa is expected to have been utilized. While there are a large number of hydroelectric sites in Ethiopia many of them are too distant from the present interconnected system, or too large for the immediate future needs of EELPA. There is no proper inventory of hydroelectric resources within reasonable transmission distance of Addis Ababa to assist in making a choice. EELPA plans to have an appropriate reconnaissance made and is seeking a grant from UNDP, or some other source, for this purpose.

III. THE PROJECT

3.01 The project would comprise the construction of the 100 MW Finchaa hydroelectric station and associated 220 kv transmission line with a length of 215 km, and terminal substation located near Addis Ababa. The project cost of US$33.8 million equivalent including interest during construction would represent 68% of the total cost of EELPA's expansion program during the project construction period, 1969-73.

Finchaa Hydroelectric Station

3.02 The Finchaa hydroelectric station would be located on the Finchaa River, a tributary of the Blue Nile, approximately 170 km northwest of Addis Ababa, as shown on the map. A low earth-filled dam located slightly upstream from the escarpment over which the river falls would enable a large storage reservoir to be created with a useful volume of 650 million cubic meters. Annual average firm production is estimated at 532 million kwh, giving a 60% plant factor.

3.03 The power station would be of the above ground conventional type equipped with three 33.3 MW generators, operating at a head of 590 meters. Pelton type turbines suitable for high head operation would be used. The main features of the civil works would be the earth-fill dam, the pressure tunnel and penstock system and the access road from the dam to the powerhouse. The dam would have a height of 20 meters and a length of about 340 meters with a total volume of earth and rock fill of 180,000 cubic meters. The 3.0 meter diameter pressure tunnel would be 4,200 meters long, leading to an inclined surface penstock 1,450 meters long. The geological conditions have been thoroughly investigated and the route of the tunnel and penstock laid out to minimize construction difficulties. No serious problems arising from geological conditions are expected.

3.04 There is no existing access to the floor of the canyon in which the power station is to be built and it is necessary to build a road, partly in tunnel, about 7 km in length. Access to the dam site on the top of the escarpment from the nearest highway will necessitate the construction of a road 90 km long following an existing trail. It is necessary to start construction of the latter road in advance of that of the project proper and a contract for this purpose has been awarded to a local firm. This road will not, therefore, be financed from the proposed loan. However, its cost is included in the cost estimate of the project.

3.05 The transmission line would be single circuit, steel tower construction, 215 km in length, generally following the route of the main access road and highway leading to Addis Ababa. It would be impractical to route it in a straight line between Finchaa and Addis Ababa in view of the rugged gorges of the Blue Nile tributaries which lie in this direction and which are almost inaccessible for construction purposes. At the Addis Ababa end of the line there would be a terminal station of 105 MVA capacity.

Estimated Cost

3.06 The estimated cost of the project is given in Annex 2 and is summarized below:

Estimated Cost of Project

	Millions of Eth$			Millions of US$		
	Local	Foreign	Total	Local	Foreign	Total
Finchaa Station						
Access Road	6.2		6.2	2.5		2.5
Civil Works	10.0	21.4	31.4	4.0	8.5	12.5
Elect. & Mech.Equipment	1.2	8.8	10.0	0.5	3.5	4.0
Engineering & Other Services	2.9 1/	2.6	5.5	1.1 1/	1.1	2.2
Contingencies	2.7	4.1	6.8	1.1	1.6	2.7
Sub-total	23.0	36.9	59.9	9.2	14.7	23.9
Transmission						
Transmission and Substation	2.9	10.1	13.0	1.2	4.0	5.2
Engineering & Other Services	0.3 1/	0.9	1.2	0.1 1/	0.4	0.5
Contingencies	0.5	1.1	1.6	0.2	0.5	0.7
Sub-total	3.7	12.1	15.8	1.5	4.9	6.4
TOTAL	26.7	49.0	75.7	10.7	19.6	30.3
Interest During Construction	-	8.8	8.8	-	3.5	3.5
GRAND TOTAL	26.7	57.8	84.5	10.7	23.1	33.8

The total cost of the project would be US$33.8 million equivalent including interest during construction of US$3.5 million. The proposed loan of US$23.1 million is for the foreign exchange cost of the project including consulting services and interest during construction. The loan would represent 68% of the estimated cost of the project. No reimbursements would be made for expenditures incurred prior to signing of the proposed loan.

3.07 The unit cost of Finchaa would be US$240 per kw excluding transmission and interest during construction and US$303 per kw when transmission is included. This is a reasonable cost for a hydroelectric plant of this size and type. The cost estimate was made by Harza Engineering Company of Chicago, consultants for the project. It is based on the feasibility study

1/ The local cost of engineering services includes the amounts to be disbursed by AID for engineering (para. 1.02).

made by Harza in 1965/66, modified for increases in cost during the interim period and reflecting the detailed design work carried out in 1968. Contingency allowance of 10% on equipment and 15% on all other construction costs have been included. Given that the tunnel-penstock system and the access road to the powerhouse, works on which considerable cost over run can be experienced, together represent almost one-third of the cost of the project, the possibility of increasing the contingency amount for construction costs was considered. However, this is considered unnecessary as the consultants are confident that the amount incorporated for contingencies is adequate given the extensive and detailed nature of the geological and other studies which have been made.

Engineering, Procurement, Construction and Disbursement

3.08 The consultants are responsible for the detailed design of the project and supervision of construction. With the exception of the 90 km access road to the dam site, which will not be financed by the Bank (para. 3.04), construction will be carried out under a civil works contract awarded on the basis of international competitive bidding. Procurement of equipment would be on the basis of international competitive bidding except for certain minor items for which such bidding would be impractical. Disbursements would be made for 100% of the foreign exchange cost of the installed/erected goods and services. The provisions contained in Loan 375-ET requiring the employment of consultants and contractors satisfactory to the Bank are repeated in the proposed agreement.

3.09 Tenders for the main contracts are to be called during the first half of 1969 and most of them should be awarded by the middle of the year. The access road to the site should be substantially completed by the rainy season in the fall of 1969 and construction would then start. The three generators are scheduled for service in 1972.

3.10 The project has already experienced some delay because of the change from AID to prospective Bank financing, since it was necessary to call for completely new bids. The construction schedule is therefore quite tight, although it can be met if undue delays are not experienced. Nevertheless, there is a considerable possibility of delay, the results of which possibility are assessed in paragraph 4.09.

IV. JUSTIFICATION OF THE PROJECT

Load Growth

4.01 Annex 3 gives the actual and forecast energy sales for the period 1964-74 for the entire system and for the interconnected system and self-contained systems, respectively. Finchaa would increase the generating capacity of the interconnected system which as noted previously, accounts for 85% of total sales.

4.02 During the five years, 1964-68, total system sales have increased at an average annual rate of about 18%, those of the interconnected system by 15% and of the self-contained systems by over 40%. The very large increase in sales of the self-contained systems reflects the provision of electricity supply to localities not previously served as well as the growth of those which were already supplied.

4.03 An average annual increase of 15.2% of total system sales, 13.0% for the self-contained systems and 15.8% for the interconnected system, is forecast for the six-year period of 1969-74. The forecast for the self-contained systems is based on past trends in the localities served and estimated sales to the areas in which new facilities are to be established; the relatively low growth rate forecast is due in part to the discontinuance starting in 1969 of off-peak sales to a textile factory. The forecast of sales to the interconnected system is based on past trends, the prospective increase in the number of consumers to be supplied, and industrial prospects.

4.04 On the interconnected system there were approximately 70,000 consumers in 1968, representing an increase of 70% during the previous five years. In 1969-74 it is estimated that the number of consumers will increase to approximately 129,000, or at roughly the same percentage rate. This is consistent with the outlook for the domestic and light commercial load category which increased at an annual average of 14.1% in the 1964-68 period and is projected to grow at an annual rate of 14.2% in 1969-74. The estimated growth of this category of service seems reasonable.

4.05 In the industrial category there are on the interconnected system some 25 consumers each purchasing more than 300,000 kwh annually. Among the larger industrial and heavy commercial consumers are textile, cement, sugar plantation and processing, tanning, fiber and other factories, and various large hotels and buildings. Prospective new large consumers include a large sugar plantation expansion involving sales of 5 million kwh annually, a pulp and paper plant with a demand of 2,000 kw, a cement plant to take about the same amount of power, the possibility of a new artificial fiber plant which might require about 40 million kwh annually, and various smaller projects including a milling plant, a tire factory, and a glass factory.

4.06 Growth of heavy commercial and industrial load on the interconnected system increased at the rate of 21.2% annually in the 1964-68 period and is estimated to grow 17.6% annually in 1969-74. Given the background of present and prospective industrial projects the projected rate of increase is reasonable.

4.07 This outlook is reinforced by the pattern of industrial development in Ethiopia. While industry as noted in paragraph 2.02 is comparatively limited for the size, population and resources of the country, it has increased in recent years at a comparatively rapid rate. Given the necessary organization and capital, future industrial growth should continue at a high rate. Since industry is predominantly in the area presently served by the interconnected system, centering in Addis Ababa, it is probable that the forecast of industrial growth on this system will be realized. If anything, the estimate might be on the conservative side. For this reason, it is important for EELPA to plan for a reasonable capacity reserve so that in the event of accelerated industrial development, power supply would not be a limiting factor. In view of the foregoing and the explanations contained in paragraphs 4.04-4.06 the load forecasts are considered sound.

System Capacity

4.08 Annex 1 tabulates existing and planned generating capacity and Annexes 4 and 5 give in chart form the relationship between capacity and demand for the peak and energy requirements of the interconnected system. It is evident that by placing the Finchaa project in service in 1972 the capacity of the interconnected system would keep pace with the demand, and some reserve capacity would be provided. The energy production from the hydroelectric stations of the interconnected system is based on dry year conditions. The reduction in output, which can be experienced at the Awash River plants in such years (paragraph 2.09), is of particular concern; in 1966 a dry year was experienced, unfortunately coinciding with a several months' delay in commissioning of the Awash II station, resulting in rationing of power. In determining the firm peak capacity, allowance has been made for the reduction in output experienced during dry years at the Awash stations, and for equipment outages.

4.09 Annexes 4 and 5 further indicate that the commissioning of Finchaa might be delayed by some six months without serious risk of a shortage of capacity. This margin provides some leeway in the event construction of Finchaa is delayed. The schedule of construction is tight (paragraph 3.10) because of the delays resulting from changing from AID to Bank financing and there is considerable possibility of delays of six months or possibly more. In any case, given the possibility of a larger industrial electricity growth than forecast (paragraph 4.07), it is advisable to maintain some margin of reserve.

Rate of Return

4.10 Annex 6 discusses the rate of return of the Finchaa project. The present worth of the revenue from the project, less expenses, over its life was determined as equalizing the cost of the project at a discount rate of 19%. The expenses applicable to the project exclude, for this purpose, the income taxes which would be payable by EELPA to the Ethiopian Government on the profits from the project, since they are a direct benefit to the economy and constitute an internal transfer. The opportunity cost of capital in Ethiopia is difficult to determine since there is no real

capital market in the country. However, the various forms of loans and credit available bear interest rates of from 6-1/2% - 9-1/2%. It is highly probable, therefore, that the estimated rate of return of the project of 19% would be in excess of the opportunity cost of capital.

Alternative Sources of Capacity

4.11 The Finchaa project represents the most economic form in which additional generating capacity can be provided, inasmuch as the cost of fuel oil is very high. There are no known fossil fuels in Ethiopia and fuel oil for use in the Addis Ababa region has to be imported through Djibouti on the Indian Ocean and transported over 700 km by rail, resulting in a cost of US$40 per ton delivered to Addis Ababa. Power produced from a thermal plant the size of Finchaa would cost about US 1.3 cents per kwh for the fuel alone. Calculation has determined that the present worth of the cost streams of the capital and operating costs of Finchaa, over its life, equals that of a similar sized thermal plant at a discount rate of about 17%. This is further indicative of the high cost of thermal power.

4.12 In view of the foregoing comments concerning load growth (paragraphs 4.01 - 4.07), system capacity (paragraphs 4.08 and 4.09), rate of return and alternative sources of capacity the project is well justified.

V. TARIFFS

5.01 EELPA's charter gives it the legal power to establish rates and regulations for the sale of electrical energy as it sees fit. However, in practice EELPA has in substance obtained the approval of the Government before changing rates.

5.02 No changes in tariffs have been made since 1960 when the Awash I hydroelectric plant went into operation. At that time rates were made uniform and were reduced about 30% for the interconnected system and by a larger percentage for the self-contained systems.

5.03 Government policy is to have EELPA charge uniform tariffs throughout the service area. The great majority of customers are served under general tariffs providing for a service charge of $1 Ethiopian per month and a kwh charge of 15¢ Ethiopian (6¢ US) for the first 100 kwh per month and 10¢ thereafter. Approximately half the customers used 25 kwh or less per month and only 13% used over 100 kwh per month. The other major and lower tariff, that for commercial and industrial sales, is comprised of a charge of 10¢ Ethiopian per kwh for the first thousand kwh per month and 5¢ thereafter. This tariff includes a customary demand charge and provides for discounts of from 5% for customers purchasing more than 100,000 kwh per month to 20% for customers purchasing more than one million kwh per month. The street lighting rate is 10¢ Ethiopian per kwh plus a service charge which results in an average price of 10.3¢ per kwh. The tariff structure is generally satisfactory but has not been studied for a number of years. Therefore a review of the tariff structure is under consideration by the management.

5.04 In 1968 sales of the interconnected system under the various tariffs were as follows:

	KWH Sold (millions)	Revenue Eth$ (millions)	Revenue % of Total	Average Rate per KWH Eth cents
General	68.6	9.18	58	13.4
Commercial and industrial	103.4	6.42	40	6.2
Street lighting	3.2	0.33	2	10.3
	175.2	15.93	100%	9.1

5.05 Loan 375-ET requires that EELPA finance at least 40% of the cost of expansion from net internal cash generation, which percentage may be revised by agreement of EELPA and the Bank. It is estimated that the expansion program can be met without a general adjustment in rates. Projected earnings after income taxes in relation to the book value of average net fixed assets in operation vary between 7.1% and 8.8% which is satisfactory.

Since the projected capital requirements in relation to internal cash generation show considerable year to year fluctuation the administration of this covenant is difficult even though it has been met in the past. Therefore there has been substituted in the proposed loan agreement a rate base-rate of return provision that the tariffs be sufficient to provide annual operating income, after deduction of income taxes, equal to no less than 7% of average net fixed assets in operation valued or revalued on a basis satisfactory to the Bank. (This approximates 9% before deduction of income taxes.)

VI. PAST OPERATIONS

6.01 Actual income statements for the fiscal years 1965-1967 and on a provisional basis for 1968 are shown in Annex 7. During this period kwh sales increased from 153 million kwh in 1965 to 221 million kwh in 1968, an annual average increase of 13%. Between 1965 and 1968 operating revenues, of which 5/6ths are obtained from the interconnected system, increased 49% and operating expenses including depreciation and income taxes increased only 37%. EELPA follows conservative accounting policies and charges all overhead expenses in connection with construction to operating revenues and does not capitalize interest during construction.

6.02 The year 1966 was a dry year and was not normal. In that year EELPA discontinued off peak sales to a steel arc furnace plant thereby reducing sales by 10 million kwh. As a result total sales increased about 9% and the average price per kwh increased 4%. Moreover, low river flows necessitated substantially higher than normal fuel expenses for steam generation, a situation which was rectified in 1967 when the Awash II hydroelectric plant came into operation.

6.03 Income taxes in accordance with applicable tax laws were levied on a graduated scale to a maximum rate of 36% with the tax payable at the top rate varying in inverse proportion to the paid-up capital. The three rates of taxation with Eth$55 million of share capital were 16% on the first Eth$412,500 of income, 26% on the next Eth$1,650,000 and 36% on the remainder.

6.04 Operating income after meeting all expenses including income taxes of EELPA and the rate of return, representing the relationships of operating income to average net fixed assets in operation, were as follows for the past four years:

Fiscal Year	Operating Income (million Eth$)	Rate of Return Before Income Taxes	Rate of Return After Income Taxes
1965	3.65	8.7%	6.4%
1966	3.98	8.8	6.9
1967	5.77	9.7	7.6
1968 (provisional)	6.53	9.3	7.2

Interest charges were covered by operating income before income taxes no less than 3.0 times in any of the years in the four year period. Past results have been satisfactory.

VII. PRESENT FINANCIAL POSITION

7.01 EELPA's financial statements are audited by Mann Judd and Co. These arrangements have been satisfactory and the proposed loan agreement contains a provision that independent auditors satisfactory to the Bank will continue to be employed. Improvement in the time lag (11 months in the 1966 fiscal year) in preparing past financial statements has been made by EELPA. Provision has been made in the proposed loan agreement that audit reports be sent to the Bank within five months of the close of each fiscal year.

7.02 The financial state of EELPA is shown in the actual and estimated balance sheets attached as Annex 8. The following summary balance sheets presented below show the actual audited data as of the end of the 1967 fiscal year and provisional data as of the end of the 1968 fiscal year.

Ethiopia Electric Light and Power Authority

Summary Fiscal Year End Balance Sheets

(million Eth$)

ASSETS	1967	Provisional 1968
Fixed Assets		
Fixed assets in operation	111.16	113.31
Less reserve for depreciation	18.98	23.03
Net fixed assets in operation	92.18	90.28
Work in progress	24.29	27.77
Total net fixed assets	116.47	118.05
Cash	4.58	11.75
Other Current Assets	6.72	7.95
TOTAL ASSETS	127.77	137.75
CAPITAL AND LIABILITIES		
Capital		
Share capital	55.00	55.00
Reserves and surplus	16.59	20.32
Total capital	71.59	75.32
Long-Term Debt	45.85	54.66
Current and other liabilities	10.33 1/	7.77 2/
TOTAL CAPITAL AND LIABILITIES	127.77	137.75

1/ Includes Eth$0.07 long-term debt due within one year.
2/ Includes Eth$1.87 long-term debt due within one year.

7.03 Fixed assets are recorded on the basis of an independent evaluation in 1957 when total fixed assets were only Eth$14.00 million which is very small in relation to subsequent additions which have been recorded at cost. The price level has been relatively stable in Ethiopia in recent years.

7.04 The provisional balance sheet indicates a strong cash position but this arises from delay in construction of projects and cash has been built up in anticipation of the substantial construction program. The Finchaa project is estimated to cost more than 60% of the book value of total fixed assets as of the end of fiscal year 1968. Capital structure is satisfactory with long term debt amounting to 43% of total capitalization. Long term debt was comprised chiefly of Eth$53.36 million drawn down under Bank Loan 375-ET out of a total loan of Eth$58.75 million. The remaining debt of EELPA is comprised of Eth$1.82 million owed to AID and a small remaining balance owed to a supplier.

7.05 Accounts and other receivables as of September 10, 1968 amounted to about Eth$3 million and bear a reasonable relationship to operating revenues of approximately Eth$20 million in that year. The figure of Eth$3 million is net after Eth$1.6 million provision for doubtful debts of which government debts dating back to 1964 and prior years account for approximately Eth$0.9 million. This debt was reduced moderately in 1968 and will be discussed with the Government during negotiations.

VIII. PROPOSED FINANCING PLAN

8.01 As shown in the forecast of the source and application of funds (Annex 9) the total expansion program is estimated to be financed through the retention of all earnings, proceeds of the proposed Bank Loan, proceeds of the existing Loan 375-ET which have not yet been fully drawn down, and modest additional borrowing from AID (paragraph 1.02). In addition it is projected that EELPA would make use of bank overdrafts which are expected to be paid off before the close of the forecast period. The following is a summary of the source and application of funds for the years 1969 through 1973:

Ethiopian Electric Light and Power Authority

Summary of Source and Application of Funds Statements
For the Years 1969 through 1973
(in millions of Eth$)

	Amount	%
APPLICATION OF FUNDS		
Construction expenditures		
Proposed Finchaa Project	73.75	63.8
Other construction	41.90	36.2
Total Application of Funds	115.65	100.0
SOURCE OF FUNDS		
Internal cash generation	74.97	
Less: Debt service	34.13	
Net internal cash generation	40.84	35.3
Long-term borrowings 1/		
Proposed IBRD Loan	57.75	50.0
IBRD Loan 375-ET	5.40	4.7
United States - AID	1.00	0.8
Total borrowings	64.15	
Other sources		
Increase in consumers' deposits	1.02	0.9
Decrease in net working capital	9.64	8.3
	10.66	
Total Source of Funds	115.65	100.0

1/ Excludes temporary bank overdrafts of up to Eth$5.00 million which would be drawn down and repaid during the forecast period as mentioned above.

8.02 Construction expenditures on the proposed Finchaa Project are estimated at Eth$75.75 million of which Eth$73.75 million will be spent during the period 1969 through 1973. Eth$2.0 million was spent in 1968. The estimated cost of the foreign portion, Eth$49.00 million, would be financed by the proposed Bank Loan which will also cover interest during the construction period amounting to Eth$8.75 million. Net internal cash generation would provide about 35% of the funds required during the period, the proposed and existing Bank loans would provide 55% and the balance of 10% would be provided principally from existing cash balances without jeopardizing EELPA's working capital position. Net internal cash generation would provide 43% of funds required over the years 1969-1974 which period includes an additional year with less heavy construction. As previously mentioned bank overdrafts would be used and paid off during the period.

8.03 For the purpose of the financial forecasts it has been assumed that the proposed Bank Loan would have a 5-year grace period, a 20-year amortization period and interest at the annual rate of 6 1/2%.

8.04 In accordance with the stated policy of EELPA, it has been assumed that no dividends will be payable in the foreseeable future, but the question may be re-examined by EELPA and the Government near the completion date of the project. The Charter of EELPA provides that dividends may be paid "only out of the surplus of net profits remaining after payment of all expenses of operation, segregation of legal and other reserves, allowances for depreciation and amounts necessary for the approved plans of expansion and extension of the business."

8.05 The projections indicate that during the construction period EELPA will temporarily require additional funds. The Authority has arranged for an increase in existing overdraft facilities to Eth$5.00 million from the Commercial Bank of Ethiopia, a state institution. The rate of interest on overdrafts is currently 9% compared with 7% at the time of consideration of Loan 375-ET.

8.06 The proposed financing plan is reasonable. During negotiations assurances were obtained that the Government, if necessary, will provide EELPA with sufficient funds to complete the Bank project.

IX. ESTIMATED FUTURE OPERATIONS

9.01 Forecast income statements for the 6-year period 1969 through 1974 are included in Annex 7. The basis of the estimates of kwh to be sold are set forth in paragraphs 4.03-4.07 inclusive, and projected power sales are shown in detail in Annex 3. Estimated revenues assume a decline in the average price per kwh reflecting expectations of an increase in average consumption for general customers on two-part tariffs and an increase in the proportion of commercial and industrial sales to total sales.

9.02 With respect to operating expenses, somewhat higher than average increases in operating, administrative and maintenance expenses are shown in the years 1971 and 1974 when new hydroelectric plants are expected to be in operation for a full year. Expenses for fuel and lubricants are expected to decline moderately toward the end of the forecast period due to expansion of the interconnected system to include part of the self contained systems and the related replacement of diesel electric generation with hydro power.

9.03 Depreciation is projected at a 3 1/2% annual straight line rate on plant in service at the end of 1968 plus subsequent additions other than hydroelectric projects. This corresponds closely to past average rates of depreciation. A straight line rate of 2 1/2% is used for the Awash III and Finchaa hydroelectric projects. These rates are reasonable.

9.04 The calculation of income taxes assumes an increase in share capital to Eth$75 million at the start of the 1970 fiscal year. With such an amount of share capital and existing higher tax rates the first Eth$562,500 of income is taxed at 20%, the next Eth$2,250,000 at 30% and the balance at 40% (see paragraph 6.03).

9.05 Operating income after income taxes as a percentage of average net fixed assets in operation is estimated over the period at between 7.1% and 7.8% with a substantially higher ratio of 8.8% in the year 1972 when there is projected practically no increase in average net fixed assets in operation. The related percentages before income tax show a range between 8.8% and 11.3%. This is satisfactory.

9.06 Estimated interest coverage before income taxes ranges generally between 2 1/2 and 3 times. After the relatively high income taxes, the ratio averages 2.1 times. Internal cash generation is expected to cover annual debt service 2.3 times on average.

9.07 Provisions have been continued in the proposed loan agreement that without approval of the Bank, EELPA will not incur any additional long-term debt unless internal cash generation (operating income before depreciation) for the fiscal year preceding such incurrence or for a later 12-month period prior to the incurrence of such debt shall be not less than 1.4 times the maximum debt service requirements for any succeeding fiscal year on all debt, including the debt to be incurred.

9.08 The capital structure of EELPA should remain sound. Long-term debt is now 43% of total capitalization and is projected at 50% at the end of the 1974 fiscal year.

X. CONCLUSIONS

10.01 The project is technically sound and the facilities to be provided are necessary to meet the expected demand for power. The estimated cost is reasonable and the arrangements for engineering, construction and procurement are appropriate. The financing arrangements are satisfactory.

10.02 EELPA is operating satisfactorily and has made good progress in improving staff organization and methods.

10.03 The project would be suitable for a Bank loan of US$23.1 million equivalent for 25 years including a grace period of 5 years.

April 10, 1969

ANNEX 1

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ETHIOPIA

THE ETHIOPIAN ELECTRIC LIGHT AND

POWER AUTHORITY

Generation Facilities

Interconnected Systems

Station	Type	Year of Installation	Nameplate Capacity (MW)
Aba Samuel	Hydro	1938	6.6
Ourso	Hydro	1953	0.4
Addis Ababa	Thermal	1956	5.0
Alemaya	Thermal	1957	2.0
Awash I (Koka)	Hydro	1960	43.2
Dire Dawa	Thermal	1966	4.5
Awash II	Hydro	1966	32.0
Awash III	Hydro	1970	32.0
TOTAL			125.7

125.7
32
93.7

Self-Contained Systems

Station	Type	Year of Installation	Nameplate Capacity (KVA)
Jimma	Thermal	1958, 60, 66	1,650
	Hydro	1962	175
Dessie	Thermal	1958, 60, 66	1,650
Hagare-Hiwot	Thermal	1967, 68	340
	Hydro	1953	210
Debra Berhane	Thermal	1964, 68	913
	Hydro	1954	110
Ghion	Hydro	1964	185
Gondar	Thermal	1959, 62	937
Yirga Alem	Thermal	1962, 68	585
Debra Marcos	Thermal	1962	250
	Hydro	1964	230
Jijiga	Thermal	1962, 68	335
Neghelli	Thermal	1961, 68, 69	375
Assab	Thermal	1964, 65	2,425
Assella	Thermal	1962, 67, 68	523
Nekemptie	Thermal	1962, 67, 68	523
Shashammane	Thermal	1962, 66	1,300
Axum	Thermal	1965, 66, 68	328
Sodda	Thermal	1966, 67, 68	443
Dilla	Thermal	1966, 68	798
Makalle	Thermal	1966, 68	613
Dembidollo	Hydro	1966	225
Bahr Dar	Hydro	1964	9,600
Asbe Teferri	Thermal	1967, 68	255
Arba Minch	Thermal	1968	255
Agarro	Thermal	1968	188
TOTAL			25,421

January 8, 1969

ANNEX 2

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ETHIOPIA

ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY

Project Cost Estimate

	Thousands of Eth$			Thousands of US$		
	Local	Foreign	Total	Local	Foreign	Total
FINCHAA HYDROELECTRIC STATION						
Civil Works						
Access Roads and Operators Village	6,200	-	6,200	2,480	-	2,480
Road, Dam to Powerhouse	1,903	4,240	6,143	761	1,696	2,457
Reservoir and Dam	1,566	1,990	3,556	626	796	1,422
Intake	290	525	815	116	210	326
Tunnel and Penstock	4,210	11,325	15,535	1,684	4,530	6,214
Powerhouse Structure	2,072	3,295	5,367	829	1,318	2,147
	16,241	21,375	37,616	6,496	8,550	15,046
Equipment						
Turbines	125	3,675	3,800	50	1,470	1,520
Generators	375	2,850	3,225	150	1,140	1,290
Electrical Equipment	346	1,094	1,440	138	438	576
Mechanical Equipment	338	1,184	1,522	136	472	608
	1,184	8,803	9,987	474	3,520	3,994
Engineering and other Services	2,875 1/	2,622	5,497	1,150 1/	1,050	2,200
Contingencies	2,700	4,075	6,775	1,080	1,630	2,710
TOTAL - FINCHAA	23,000	36,875	59,875	9,200	14,750	23,950
TRANSMISSION						
Switching Station	118	2,255	2,373	47	902	949
Transmission Line	2,630	7,050	9,680	1,052	2,820	3,872
Substation	191	820	1,011	76	328	404
Engineering	322 1/	875	1,197	130 1/	350	480
Contingencies	439	1,125	1,564	195	450	645
TOTAL - TRANSMISSION	3,700	12,125	15,825	1,500	4,850	6,350
TOTAL - PROJECT	26,700	49,000	75,700	10,700	19,600	30,300

1/ The local cost of engineering services includes the amounts to be disbursed by AID for engineering prior to signing of the proposed Loan.

March 21, 1969

ETHIOPIA

ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY

Summary

Actual and Forecast Energy Sales 1964 - 1974
(millions of kwh)

	INTERCONNECTED SYSTEM			SELF-CONTAINED SYSTEMS			TOTAL	
	kwh	% Increase	% of Total Sales	kwh	% Increase	% of Total Sales	kwh	% Increase
				ACTUAL				
1964	107.79	19.7	86.5	16.83	137.0	13.5	124.62	28.3
1965	125.97	16.9	82.7	26.30	56.3	17.3	152.27	22.2
1966	134.98	7.2	81.2	31.34	19.2	18.8	166.32	9.2
1967	162.20	20.2	82.0	35.70	13.9	18.0	197.90	19.0
1968	181.81	12.1	82.2	39.32	10.1	17.8	221.13	11.7
				FORECAST				
1969	205.0	12.8	85.8	34.0	(13.5)	14.2 1/	239.0	8.1
1970	239.0	16.6	85.7	40.0	17.6	14.3	279.0	16.7
1971	283.0	18.4	85.8	47.0	17.5	14.2	330.0	18.3
1972	330.0	16.6	85.5	56.0	19.1	14.5	386.0	17.0
1973	380.0	15.2	85.1	66.5	18.8	14.9	446.5	15.7
1974	438.0	15.3	84.7	79.0	18.8	15.3	517.0	15.8

1/ Reduction in sales due to discontinuance of sales of off-peak power on self-contained systems in 1969.

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ETHIOPIA

ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY

Actual and Forecast Sales 1964 - 1974
(millions of kwh)

	General			Commercial and Industrial			Public Lighting			Off-Peak		Total		
	kwh	% Incr.	% of Total	kwh	% Incr.	% of Total	kwh	% Incr.	% of Total	kwh	% of Total	kwh	% Incr.	% of Total
INTERCONNECTED SYSTEM							ACTUAL							
1964	40.84	15.0	32.8	47.24	19.4	37.9	2.22	15.0	1.8	17.49	14.0	107.79	19.7	86.5
1965	46.17	13.1	30.3	65.14	37.9	42.8	2.31	4.1	1.5	12.35	8.1	125.97	16.9	82.7
1966	52.23	13.1	31.4	77.81	19.5	46.8	2.58	11.7	1.6	2.36	1.4	134.98	7.2	81.2
1967	60.28	15.4	30.5	94.10	20.9	47.5	2.83	9.7	1.4	4.99	2.6	162.20	20.2	82.0
1968	68.56	13.7	31.0	103.51	10.0	46.8	3.17	12.0	1.4	6.57	3.0	181.81	12.1	82.2
							FORECAST							
1969	78.16	14.0	32.7	118.32	14.3	49.5	3.52	11.0	1.5	5.0	2.1	205.0	12.8	85.8
1970	89.88	15.0	32.2	140.21	18.5	50.3	3.91	11.0	1.4	5.0	1.8	239.0	16.6	85.7
1971	102.91	14.5	31.2	170.75	21.8	51.8	4.34	11.0	1.3	5.0	1.5	283.0	18.4	85.8
1972	117.32	14.0	30.4	202.86	18.8	52.6	4.82	11.0	1.2	5.0	1.3	330.0	16.6	85.5
1973	133.74	14.0	30.0	235.91	16.3	52.8	5.35	11.0	1.2	5.0	1.1	380.0	15.2	85.1
1974	152.46	14.0	29.5	274.60	16.4	53.1	5.94	11.0	1.1	5.0	1.0	438.0	15.3	84.7
SELF-CONTAINED SYSTEMS							ACTUAL							
1964	7.08	44.8	5.7	4.35	148.0	3.5	.56	21.7	0.4	4.84	3.9	16.83	137.0	13.5
1965	8.03	13.4	5.3	8.26	89.9	5.4	.65	16.1	0.4	9.36	6.2	26.30	56.3	17.3
1966	9.41	17.2	5.7	11.98	45.2	7.2	.86	32.3	0.5	9.09	5.4	31.34	19.2	18.8
1967	12.04	27.9	6.1	11.80	(1.6)	5.9	1.04	20.9	0.5	10.82	5.5	35.70	13.9	18.0
1968	14.60	21.3	6.6	12.91	9.4	5.8	1.31	26.0	0.6	10.50	4.8	39.32	10.1	17.8
							FORECAST							
1969	18.23	24.9	7.6	14.20	10.0	5.9	1.57	20.0	0.7	--	--	34.0	(13.5)	14.2
1970	22.48	23.3	8.0	15.62	10.0	5.6	1.90	21.0	0.7	--	--	40.0	17.6	14.3
1971	27.50	22.3	8.3	17.18	10.0	5.2	2.32	22.0	0.7	--	--	47.0	17.5	14.2
1972	34.27	24.6	8.9	18.90	10.0	4.9	2.83	22.0	0.7	--	--	56.0	19.1	14.5
1973	42.26	23.3	9.4	20.79	10.0	4.7	3.45	22.0	0.8	--	--	66.5	18.8	14.9
1974	51.92	22.9	10.1	22.87	10.0	4.4	4.21	22.0	0.8	--	--	79.0	18.8	15.3

January 8, 1968

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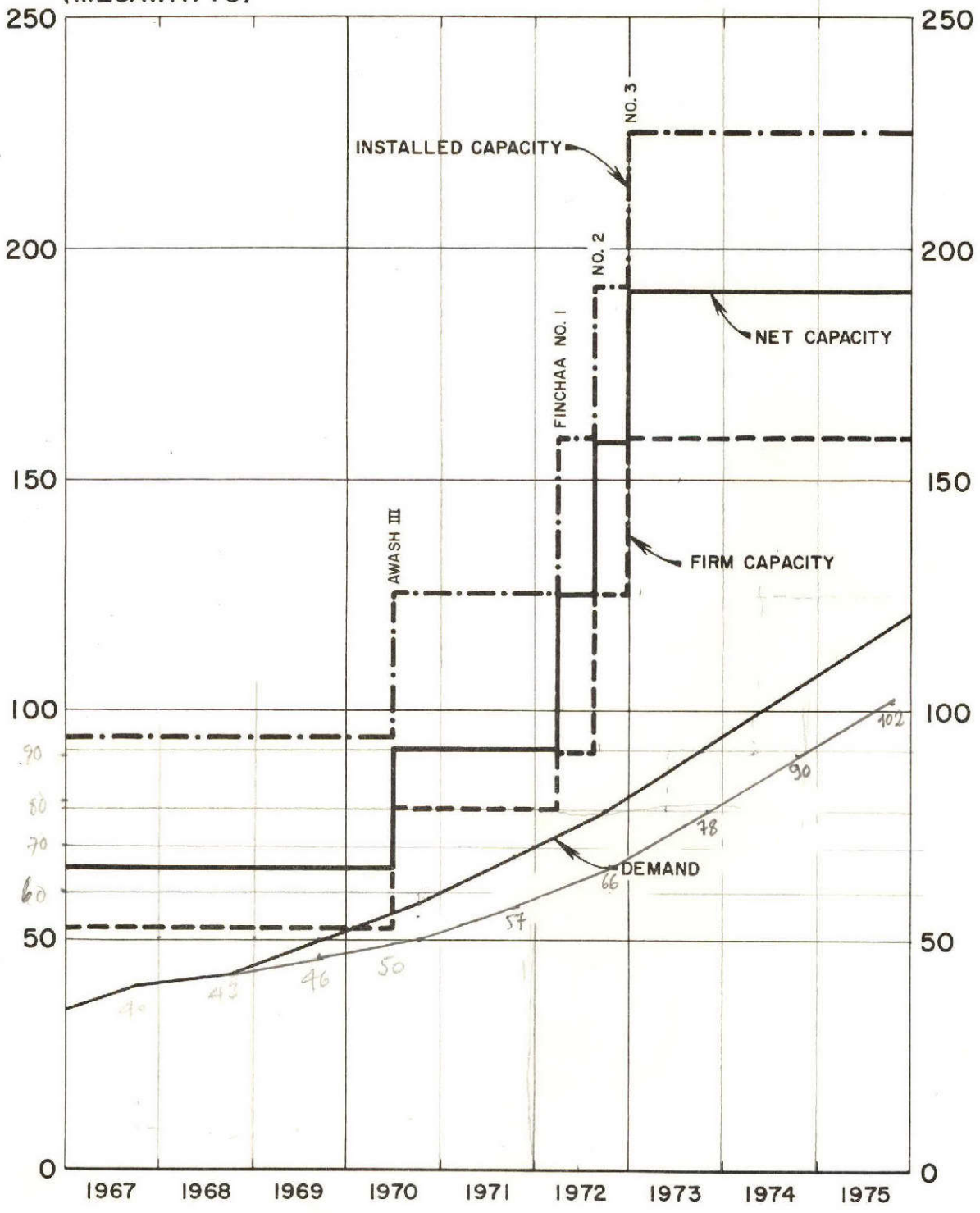
ANNEX 4

ETHIOPIA: ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY

INTERCONNECTED SYSTEM

SYSTEM CAPACITY AND DEMAND

(MEGAWATTS)



NOTES: Net Capacity – Installed capacity adjusted for loss in output during dry years.
Firm Capacity – Net capacity less provision for maintenance and outages.
System Demand – Estimated load demand plus losses.

(R)IBRD-4218

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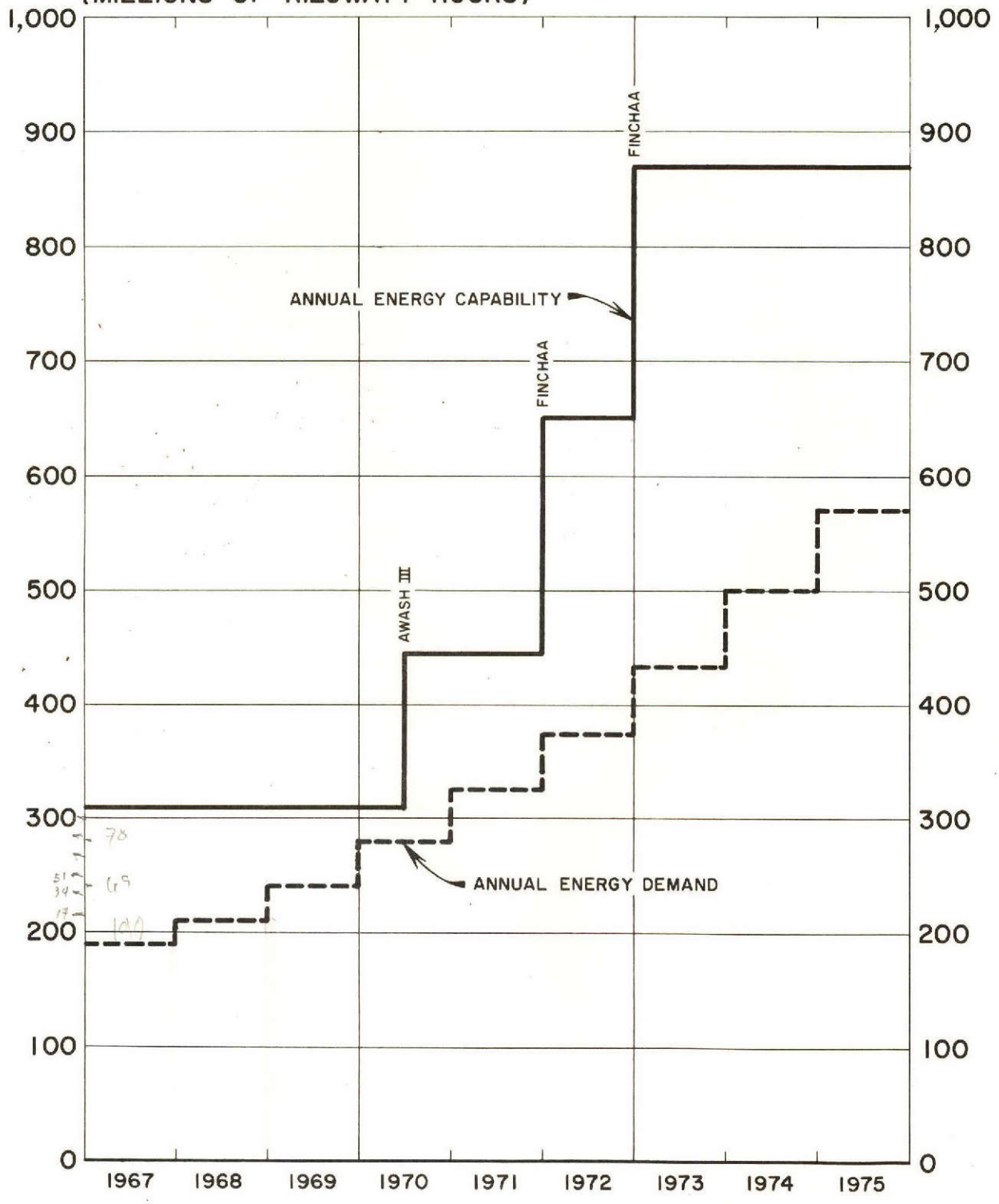
ANNEX 5

ETHIOPIA: ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY

INTERCONNECTED SYSTEM

ENERGY CAPABILITY AND ENERGY DEMAND

(MILLIONS OF KILOWATT HOURS)



NOTES: Annual Energy Capability – System energy capability, driest year.
Annual Energy Demand – Estimated energy sales plus losses.

IBRD-4219

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ETHIOPIA

THE ETHIOPIAN ELECTRIC LIGHT AND

POWER AUTHORITY

Rate of Return on the Project

1. The rate of return of the Finchaa project is taken for the purpose of this calculation to be the discount rate at which the present worth of the cost of the project equals the present worth of the net revenue deriving from it over its life.

2. The following information and assumptions were used in calculating the rate of return:

a. To the capital cost of the project has been added the cost of transmission/distribution facilities which would be provided to distribute the output of Finchaa. A project life of 40 years is assumed.

b. Annual net revenue equal to annual gross revenue less operating costs. Annual gross revenue is equal to the annual kwh sales attributed to Finchaa multiplied by the applicable tariff. For the purpose of calculating the rate of return, operating costs exclude the income tax levy on profits. That is, net revenue is the revenue before income taxes are applied since income taxes are a direct benefit to the economy, and constitute an internal transfer in the economy of the country.

c. It is estimated that it would be 1978-79 before the full energy output of Finchaa would be utilized. Annual kwh sales applicable to Finchaa in the 1973-79 period are based on its estimated contribution to sales each year.

d. It is assumed that the average revenue per kwh from Finchaa would be US 3.2 cents per kwh in the period 1973-79 and US 2.4 cents thereafter. The former corresponds to the average price which would apply about 1974, and which is slightly less than the average in the 1970-74 period. However, it is expected that as the Finchaa output becomes absorbed into the system the benefits of the comparatively low cost power produced from it would be reflected in some reduction in tariffs. The tariff assumed starting in 1980 is based on this premise. This is admittedly an arbitrary assumption. The ultimate tariff is not likely to be less than 2.4 US cents. If it should prove higher, the revenue and consequently the rate of return, would be larger.

e. Gross operating expenses include the incremental costs of operation applicable to Finchaa as well as the cost of operating and distribution facilities over which Finchaa production would be distributed.

3. The rate of return is estimated at 19%. The assumptions are on the conservative side and the figure of 19% can likewise be assumed conservative. Moreover, it is reasonable to believe that the real worth of the output from Finchaa to the economy is somewhat higher than the rates charged by EELPA.

4. There is no real capital market in Ethiopia from which the opportunity cost of capital can be ascertained. However, the various forms of loans and credit available, including commercial bank loans for periods up to five years, saving association lendings, government bonds, and bank overdrafts all bear interest rates in the range of 6.5 - 9.5%. It is therefore probable that the rate of return of 19% on Finchaa is substantially greater than the opportunity cost of capital in Ethiopia.

ETHIOPIA

ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY

Rate of Return of Project

	Capital Expenditure Millions US$	Annual Sales, Finchaa Millions kwh	Annual Revenue, Finchaa Millions US$	Annual Operating Expenses Finchaa Millions US$	Annual Net Revenue, Finchaa Millions US$
1973	36.9 1/	30	0.70	0.70	-
1974	1.2 2/	60	1.92	0.75	1.17
1975	1.2	130	4.15	0.80	3.35
1976	1.2	210	6.72	0.85	5.87
1977	1.2	300	9.60	0.90	8.70
1978	1.2	390	12.50	0.95	11.55
1979	1.2	430	13.80	1.00	12.80
1980	1.2	530	12.70	1.05	11.65
1981	-	530	12.70	1.05	11.65
1982	-	530	12.70	1.05	11.65
"	"	"	"	"	"
"	"	"	"	"	"
"	"	"	"	"	"
2013	-	530	12.70	1.05	11.65
Present Worth 1973, Discount Rate 19.3%	41.9				41.9

1/ Includes cost of Finchaa and distribution capital expenditures, and interest charges during construction period thereon.

2/ Annual expenditure on distribution for Finchaa estimated US$1.2 million until 1980.

February 3, 1969

ETHIOPIA

ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY

Actual and Estimated Income Statements
(in millions of Ethiopian Dollars)

Year Ending September 10	Actual 1965	Actual 1966	Actual 1967	Provisional 1968	Estimated 1969	Estimated 1970	Estimated 1971	Estimated 1972	Estimated 1973	Estimated 1974
Sales (millions of kwh)	152.3	166.3	197.9	221.1	239.0	279.0	330.0	386.0	446.5	517.0
Average price per kwh (Eth. cents)	8.84	9.15	8.94	9.06	9.10	8.89	8.79	8.58	8.40	8.16
Operating Revenues	13.47	15.21	17.70	20.03	21.80	24.80	29.00	33.10	37.50	42.20
Operating Expenses										
Operating, administrative and maintenance expenses	4.62	5.36	5.77	6.75	7.90	8.70	9.80	10.70	11.40	12.30
Fuel and lubricants	1.54	2.22	1.15	0.95	1.35	1.82	1.91	2.06	1.95	1.80
Depreciation	2.40	2.55	3.44	3.80	4.06	4.68	5.35	5.64	6.84	8.04
Income taxes	1.26	1.10	1.57	2.00	1.85	1.92	2.54	3.28	4.05	5.07
Total operating expenses	9.82	11.23	11.93	13.50	15.16	17.12	19.60	21.68	24.24	27.21
Operating Income	3.65	3.98	5.77	6.53	6.64	7.68	9.40	11.42	13.26	14.99
Interest Charges - Annex 9	0.67	1.35	2.19	2.80	3.15	3.95	4.72	5.64	6.32	6.53
Net Income	2.98	2.63	3.58	3.73	3.49	3.73	4.68	5.78	6.94	8.46
Times interest charges covered by operating income										
before income taxes	7.3	3.8	3.4	3.0	2.7	2.4	2.5	2.6	2.7	3.1
after income taxes	5.4	2.9	2.6	2.3	2.1	1.9	2.0	2.0	2.1	2.3
Operating income - % of average net fixed assets in operation										
before income taxes	8.7	8.8	9.7	9.3	9.3	8.8	9.4	11.3	10.2	9.7
after income taxes	6.4	6.9	7.6	7.2	7.3	7.1	7.4	8.8	7.8	7.2

March 21, 1969

Annex 7

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ETHIOPIA

ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY

Actual and Estimated Balance Sheets
(in millions of Ethiopian Dollars)

September 10	Actual 1965	Actual 1966	Actual 1967	Provisional 1968	Estimated 1969	Estimated 1970	Estimated 1971	Estimated 1972	Estimated 1973	Estimated 1974
ASSETS										
Fixed Assets										
Fixed assets in operation (a)	69.10	73.84	111.16	113.31	118.81	157.46	166.23	173.73	256.73	264.23
Less reserve for depreciation	12.70	15.00	18.98	23.03	27.09	31.77	37.12	42.76	49.60	57.64
Net fixed assets in operation	56.40	58.84	92.18	90.28	91.72	125.71	129.11	130.97	207.13	206.59
Work in progress	19.15	41.81	24.29	27.77	38.27	25.50	48.00	67.50	-	5.00
Total net fixed assets	75.55	100.65	116.47	118.05	129.99	151.21	177.11	198.47	207.13	211.59
Current Assets										
Cash	4.75	1.88	4.58	11.75	7.78	0.57	(4.51)	(4.42)	0.49	1.87
Accounts receivable and prepayments	3.44	4.16	3.43	4.68	5.00	5.50	6.20	6.90	7.60	8.40
Materials and supplies	2.74	2.80	3.29	3.27	3.50	4.00	4.30	4.60	5.50	5.90
Total current assets	10.93	8.84	11.30	19.70	16.28	10.07	5.99	7.08	13.59	16.17
Total assets	86.48	109.49	127.77	137.75	146.27	161.28	183.10	205.55	220.72	227.76
CAPITAL AND LIABILITIES										
Capital										
Share capital	55.00	55.00	55.00	55.00	55.00	75.00	75.00	75.00	75.00	75.00
Reserves and surplus	11.28	13.91	16.59	20.32	23.81	7.54	12.22	18.00	24.94	33.40
Total capital	66.28	68.91	71.59	75.32	78.81	82.54	87.22	93.00	99.94	108.40
Long-term Debt										
English Electric	0.12	0.04	-	-	-	-	-	-	-	-
IBRA, Yugoslavia	1.55	1.49	1.42	1.35	1.08	0.81	0.54	0.27	-	-
IBRD Loan No. 375-ET	12.81	31.45	44.50	53.36	55.26	55.46	53.66	51.76	49.76	47.66
Proposed IBRD Loan	-	-	-	-	1.65	12.53	30.72	48.42	57.75	57.01
United States - AID	-	-	-	1.82	2.82	2.82	2.82	2.82	2.82	2.82
Total Long-term Debt	14.48	32.98	45.92	56.53	60.81	71.62	87.74	103.27	110.33	107.49
Less debt due within one year	0.14	0.11	0.07	1.87	1.97	2.07	2.17	2.27	2.84	3.77
Net Long-term Debt	14.34	32.87	45.85	54.66	58.84	69.55	85.57	101.00	107.49	103.72
Consumers' Deposits	2.11	2.40	2.65	2.98	3.20	3.40	3.60	3.80	4.00	4.20
Current Liabilities										
Long-term debt due within one year	0.14	0.11	0.07	1.87	1.97	2.07	2.17	2.27	2.84	3.77
Accounts payable and accruals	2.29	4.35	6.04	1.42	1.60	1.80	2.00	2.20	2.40	2.60
Provision for taxes	1.32	0.85	1.57	1.50	1.85	1.92	2.54	3.28	4.05	5.07
Total current liabilities	3.75	5.31	7.68	4.79	5.42	5.79	6.71	7.75	9.29	11.44
Total Liabilities	86.48	109.49	127.77	137.75	146.27	161.28	183.10	205.55	220.72	227.76
Debt/Equity Ratio	18/82	32/68	39/61	43/54	44/56	46/54	50/50	53/47	52/48	50/50
Percentage of long-term debt including long-term debt due within one year to total net fixed assets	19%	33%	39%	48%	47%	47%	50%	52%	53%	51%

(a) At independent valuation in 1957 and subsequent additions at cost.

March 21, 1969

Annex 8

ETHIOPIA

Annex 9

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ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY

Estimated Source and Application of Funds Statements
(in millions of Ethiopian Dollars)

Year Ending September 10	1969	1970	1971	1972	1973	1974	Six-Year Total 1969-1974
SOURCE OF FUNDS							
Internal Cash Generation							
Operating income	6.64	7.68	9.40	11.42	13.26	14.99	63.39
Depreciation	4.06	4.68	5.35	5.64	6.84	8.04	34.61
Total internal cash generation	10.70	12.36	14.75	17.06	20.10	23.03	98.00
Increase in consumers' deposits	0.22	0.20	0.20	0.20	0.20	0.20	1.22
Borrowings							
IBRD Loan No. 375-ET	3.50	1.90	-	-	-	-	5.40
Proposed IBRD Loan (Finchaa)	1.65	10.88	18.19	17.70	9.33	-	57.75
United States - AID	1.00	-	-	-	-	-	1.00
Total borrowings	6.15	12.78	18.19	17.70	9.33	-	64.15
Total Source of Funds	17.07	25.34	33.14	34.96	29.63	23.23	163.37
APPLICATION OF FUNDS							
Construction Expenditures (No interest during construction)							
Proposed IBRD Finchaa Project							
Foreign	1.50	10.00	16.50	15.00	6.00	-	49.00
Local	5.50	6.50	6.00	4.50	2.25	-	24.75
Total	7.00	16.50	22.50	19.50	8.25	-	73.75
Interconnected System	1.50	2.75	4.00	2.75	3.00	2.88	16.88
Self-contained Systems-Miscellaneous	4.00	4.75	4.75	4.75	4.25	4.62	7.12
IBRD Loan 375-ET Project							
Foreign	3.50	1.90	-	-	-	-	5.40
Future Hydro Project	-	-	-	-	-	5.00	5.00
Total Construction Expenditures	16.00	25.90	31.25	27.00	15.50	12.50	128.15
Debt Service							
Interest							
INGRA, Yugoslavia (3% rate)	0.04	0.03	0.02	0.01	0.01	-	0.11
IBRD Loan No. 375-ET (5½% rate)	2.96	3.04	3.01	2.93	2.82	2.71	17.47
Proposed IBRD Loan	0.15	0.88	1.69	2.70	3.49	3.82	12.73
Total interest	3.15	3.95	4.72	5.64	6.32	6.53	30.31
Amortization							
INGRA, Yugoslavia	0.27	0.27	0.27	0.27	0.27	-	1.35
IBRD Loan No. 375-ET	1.60	1.70	1.80	1.90	2.00	2.10	11.10
Proposed IBRD Loan	-	-	-	-	-	0.74	0.74
Total amortization	1.87	1.97	2.07	2.17	2.27	2.84	13.19
Total Debt Service	5.02	5.92	6.79	7.81	8.59	9.37	43.50
Increase or (Decrease) in Net Working Capital excluding cash							
Accounts receivable and prepayments	0.32	0.50	0.70	0.70	0.70	0.80	
Materials and supplies	0.23	0.50	0.30	0.30	0.90	0.40	
Accounts payable and accruals	(0.18)	(0.20)	(0.20)	(0.20)	(0.20)	(0.20)	
Provision for taxes	(0.35)	(0.07)	(0.62)	(0.74)	(0.77)	(1.02)	
Total increase or (decrease) in net working capital	0.02	0.73	0.18	0.06	0.63	(0.02)	1.60
Total Application of Funds	21.04	32.55	38.22	34.87	24.72	21.85	173.25
Net Cash Accrual or (Deficit)	(3.97)	(7.21)	(5.08)	0.09	4.91	1.38	(9.88)
Cash Balance Beginning of Year	11.75	7.78	0.57	(4.51)	(4.42)	0.49	
Cash Balance End of Year 1/	7.78	0.57	(4.51)	(4.42)	0.49	1.87	
Times annual debt service covered by internal cash generation	2.1	2.1	2.2	2.2	2.3	2.5	2.3

1/ Year end cash deficits will be covered by overdraft arrangements (see paragraphs 8.01 and 8.05)

March 21, 1969

ETHIOPIAN ELECTRIC LIGHT AND POWER AUTHORITY GENERATING STATIONS AND MAIN TRANSMISSION LINES

POWER PLANTS UNDER E.E.L.P.A.
- Hydroelectric power plants completed
- Thermal power plants completed
- Substations completed
- Transmission lines completed
- Project shown in red
- International boundries
- Provincial capitals
- Rivers
- All weather roads

0 10 20 40 60 80 100 120 140 160 180 200 KILOMETERS

RED SEA
GULF OF ADEN
SUDAN
KENYA
SOMALIA
SOMALIA

Massawa, ASMARA, Adi Abun, Axum, Adowa, MEKELE, LAKE JULET, Assab, GONDAR, LAKE TANA, Dinder R., Bahar Dar, Tis Abbai, Addy R., DESSIE, LAKE HAIK, Djibouti, LAKE ABBE, Awash R., DEBRE MARCOS, Blue Nile R., FINCHAA HYDRO-ELECTRIC STATION, ADDIS ABABA, Debre Berhan, Dire Dawa, LEKEMTI, Addis Alem, Akaki, Debre Zeit, Modjo, Ambo, Metahara, Asbe, Alemaye, HARRAR, Jijiga, Dembidolo, Ghion, Hera, AWASH III, AWASH II, AWASH I, Awash R., Gibi R., LAKE ZWAI, ASSELA, Webi Shebele R., JIMMA, LAKE ABIATA, LAKE SHALLA, LAKE LANGANO, Gogeb R., Shashmane, Soddo, YIRGALEM Wondo, Omo R., LAKE ABAYA, ARBA MINCH, LAKE SHAMO, Negele, Sagan R., LAKE STEFANIE, Dawa R., LAKE RUDOLF

JANUARY 1969

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