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ELECTRIC POWER IN BRITISH HONDURAS (BELIZE)

Report prepared by the Central American Electrification and Water Resources Mission of the BTAO. It has not been cleared with the Bureau of Technical Assistance Operations of the United Nations, which does not, therefore, necessarily share the views expressed. This is a preliminary version subject to final revision.

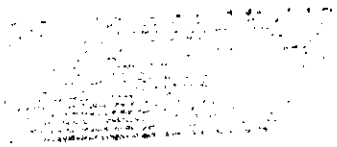


TABLE OF CONTENTS

1. Introduction

The electrical industry in British Honduras, at the national level, has undergone a rather slow development due to the scarcity of population and the consequent low rate of industrial development. With the exception of the capital city of Belize, which has an adequate electricity service, and some private industries which have their own power plants, the supply of electricity throughout the country is insufficient. This situation constitutes a serious obstacle to the balanced economic development of the country.

The official institution that handles the electric system in the city of Belize is highly efficient. However, in the rest of the country, the equivalent official institutions are unfit to handle the electricity supply since they do not have the necessary know-how, thus making more difficult the tackling of the electrification problem on a national scale. For the above mentioned reasons the cost of electricity is high, which in turn restricts the consumption of energy and further impairs the already unfavorable balance of payments of the country.

British Honduras has very favorable hydraulic resources for the production of energy; however, despite the specific recommendations of preliminary studies made 10 years ago, no collection of basic river flow data or systematic evaluation type studies of these resources has been started up to the present. The lack of this valuable information will delay the eventual integration of the more important electrical systems of the region whose feasibility depends greatly on the utilization of low cost hydro power, and as a direct consequence the general economic activity of the country will be hindered. Moreover, this delay will mean a serious draw-back to the solution of the problems of water supply for human and industrial consumption in the great majority of the towns, which due to their surrounding flat topography, need reliable low cost electric power for pumping.

This report contains an analysis of this problem in British Honduras and the recommendations for its most favorable solution, based on the information available to us at present. Furthermore, a study is made of the advantages to British Honduras if it were to associate with other countries of Central America in the coordination of their respective electrification and water resources development programmes.

/2. Status

2. Status of the electrical energy supply in British Honduras

The total installed capacity in British Honduras includes 3 602 kW of public power and 3 185 kW of private power (47 per cent of total). The former produced 9.7 million kWh while the latter 8.6 million kWh in the year 1963 (see tables 1, 2 and 3 of Annex B). These figures result in annual per capita[1/] values of 68 watts and 185 kWh which are above the mean values registered for Central America in that same year.

The only areas that have electric service are some of the urban zones where the isolated government plants operate. With the exception of the city of Belize, which has 24 hour-service, in the rest of the towns the electricity service is usually limited to 6 hours at night.

The energy consumption is restricted due to its poor quality and the limited offer, making the per capita demand in these towns about one third of that of the city of Belize. The rural areas have no electricity whatsoever, with the possible exception of privately-owned small plants for the use of well-to-do farmers.

Some of the industries use part of the steam required for the industrial processes in the generation of electrical energy (sugar mills and citrus plants). Of these the Corozal sugar mill used in 1963 sugar cane straw as fuel to produce part of its energy, while the rest of the industries had to use imported fuels. In this connexion it is worth mentioning that the total importation of fuels for the generation of electricity in both private and public plants amounted, in round numbers, to 250 000 B.H. dollars, which represents approximately 3 per cent of the total domestic exports.

The consumption of energy throughout the year seems to have well defined variations caused by the increased activities for the handling of crops (December to May for the sugar mills and October to May for citrus plants) and by the fishing seasons, that tax to their maximum the freezing chambers and ice factory in the City of Belize. The typical daily and monthly load curves in a future interconnected system (including only a small percentage of industrial load) will correspond approximately to the ones obtained at present for the City of Belize (see table 4 of Annex B), relating basically to a high domestic load and specifically to lighting, air conditioning and electric fans. This assumption is based on the fact

1/ British Honduras estimated population up to 31-12-63 was 99,400 inhabitants.

/that

that climatological conditions are similar throughout the region being considered and the familiar customs and average per capita income do not show great variations. The average annual load factor observed for 1963 was 51 per cent and for a typical week day 63 per cent, values which are considered normal for systems of similar characteristics.

The public electric enterprises are owned by the State.

If the entire country is viewed as a unit, the poor utilization of the total installed capacity becomes readily apparent. This situation can be measured by the total number of hours of effective usage in a year's time as shown in table A. The results point out the true nature of the electric problem in the country, which can be described as follows: Isolated plants serving underdeveloped markets and private industries self-supplied. This latter condition restrains the incipient development of the industry. The most important of them is the Belize Electricity Board, a decentralized entity which efficiently operates the electricity service in the city of Belize. In the rest of the principal cities (see table of Annex B) the small diesel electricity plants and the corresponding distribution systems are operated by local town Boards which are not technically qualified for this kind of service, and as a result the electricity is of poor quality and very expensive. Also the handling of the electricity is considered by the local Boards more as an additional source of revenue than as a service to the community.

The 1961 hurricane caused severe damage to the generating plants as well as the transmission and distribution systems throughout the country. This situation served to show the high quality of organization of the Belize Electricity Board which was able to restore normal service after a short period of intense work. The same cannot be said for the other towns such as Stann Creek where, up to the present, the electricity service has not been restored. In the City of Belize the generating plant, the transmission and the distribution systems look neat and well-kept, having been designed for hurricane conditions at least similar to the one which occurred in 1961. In the small cities the majority of the generating plants and distribution systems are old, and cannot be considered to be in proper operating condition.

/Table A

Table A

CENTRAL AMERICA AND BRITISH HONDURAS: INSTALLED CAPACITY, ELECTRIC PRODUCTION PER CAPITA, AND UTILIZATION OF GENERATION CAPACITY, 1963

Public Utilities and Private Installations

Country	Installed capacity watts per capita	Electricity production kWh per capita	Utilization of generation capacity	
			Hours per year	Per cent of year
Guatemala	22	89	4 050	46,2
El Salvador	39	124	3 200	36,5
Honduras	19	58	3 050	34,8
Nicaragua	48	154	3 200	36,5
Costa Rica	112	388	3 460	39,5
Central America	39	135	3 460	39,5
British Honduras a/	68	185	2 720	31,0

Source: Electric Statistics from Central America and Belize Electricity Board data.

a/ Population estimate in 99 400 inhabitants at 31 December 1963.

/The prices

The prices charged for the use of electrical energy are approximately 60 per cent higher than the ones for similar systems in the Central American countries (see table B). In the City of Belize the prices in general are lower than in the rest of the country. The existing tariffs result in reduced costs for higher consumption, and in slightly lower prices for domestic consumers than for commercial and industrial users for equal consumption. (See table 5 of Annex B.)

The Electricity Board in Belize City is continuously promoting the consumption of energy by carrying out industrial activities of its own such as freezing chambers and an ice factory) and by an active programme of selling and renting electrical appliances to the consumers similar to the ones carried out, at their start, by the rural electricity cooperatives in the United States. These activities have given the Electricity Board excellent economic results and have also resulted in a considerable increase in energy consumption, evidenced by the fact that in December 1963 the total energy used was 22 per cent higher than in December of the previous year. The experience already obtained in the handling of these activities could be advantageously followed in the rest of the communities receiving electric service and adapted to many areas of Central America.

It is convenient to point out the magnificent higher management of the Belize Electricity Board which has resulted in a highly efficient administration evidenced by the economic results obtained (electrical activities only) for the year 1963. (See Table 6 of Annex B). The Board's net income (total revenues minus operating expenses and depreciation) for that year was 181 200 B.H. dollars equivalent to a return of 12,3 per cent on fixed capital (gross fixed assets minus accumulated depreciation plus working capital) which compares favorably with the average similar returns obtained by the most important electrical enterprises in Central America. The total cash income (net income plus depreciation) for that same year amounted to 254,000 B.H. dollars which could serve to safely cover a considerable loan for new investment. If the other activities of the Electricity Board already mentioned were to be included the economic results would be even better.

/Table B

Table B

CENTRAL AMERICA AND BRITISH HONDURAS: AVERAGE INCOME PER KWH PUBLIC UTILITIES, 1963

Country	Average income per kWh (Cents of dollar)	Number of customers (Thousands)	Average consumption per customer (kWh)
Guatemala	3,62	114,0	2,480
El Salvador	3,25	102,8	2 710
Honduras	4,80	35,3	2 210
Nicaragua	3,80	60,0	2 125
Costa Rica	2,01	111,0	3 840
Central America	3 04	423,1	2.760
British Honduras[a/]	4,77	5,2	1 570

Source: Electric statistics of Central America and British Honduras.
a/ Includes only the city of Belize.

/The special

The special political situation of British Honduras has made difficult the access of their small electrical enterprise to the international money markets, contrary to the experience already obtained by the Central American countries. This fact has limited credit in British Honduras which, for other countries of the region, have reached equity/debt ratios of the order of 40/60. The Belize Electricity Board has been depending on short-term loans from industrial concerns or the Government without making use of the long-term type loans. This situation has been made possible due to their efficient management and their high tariffs. However, as the systems grow and a national solution to the electricity problem, based on a high standard of low-cost service on a country-wide basis, becomes a necessity, long term loans will become imperative. On this subject it is important to remember that the rehabilitation of the electricity system in Belize after the 1961 hurricane was made possible largely by funds donated by the British Government. Until now, the interest in the electricity problem has been rather limited to the operation of the best electrical market in the country (Belize City) without major concern over the price of the energy to be used by the individual consumer, the supply of electricity to the rest of the country, or the improvement of the economy through the advantageous utilization of the hydroelectric potential.

3. Future electric development in British Honduras (years 1964-1975)

a) General

In the following pages a study is made of a possible expansion programme for the electricity systems of the most important areas in the country. This study is aimed at establishing the general features of such a development in order to point out and reinforce the recommendations for subsequent action based on this report.

Consideration was given to several alternative solutions, including the use of thermal power plants only, and the combination of thermal and hydropower to serve an integrated system comprising the most important cities of the Central and Northern region of the country. For the sake of simplification the few isolated plants in the Southern area have not been included in this report. The most favorable alternative for the economy of Belize,

/consisting

consisting of thermal and hydro-power combination, is explained further on in certain detail in order to make more clear the necessity of carrying out a number of studies to attain in due time the minimum goals proposed in the programme.

The assumption of highest implications within the proposed programme is the one referring to the existence of a favorable hydro-electric potential of considerable magnitude that could be utilized economically. Specifically, the plan contemplates the construction of the hydroelectric project "Vaca-Falls" which would utilize the waters of the Macal River (Eastern Branch of the Belize River) and of its tributaries, San Juan River and Privassion Creek. This project was evaluated in a preliminary study made in 1952 by engineers of the English consulting firm of Sir William Halcrow and Partners, who considered that it was possible to install from 10 to 12 MW in two projects within that zone. Unfortunately, in spite of the recommendations made at that time regarding the collection of river flow data in the zones most likely to have hydroelectric potential, nothing has yet been done to start a stream gauging programme. On the other hand, there are several rain gauging stations within the area where continuous records are being kept (see Table 7 of Annex B). This information will be of great importance for the extrapolation of the meager river flow data that should be obtained from now until the initiation of the construction of the first project, which could be started by 1968-69, assuming a tight schedule. Similar situations regarding the lack of sufficient river flow data from direct measurements have already been confronted in Central America. However, they have been solved using conservative assumptions as to the available flows and keeping the designs flexible enough to accommodate future modifications as more information becomes available.

b) Power Market (1964-1975)

The power market study is based on the assumption that it will be feasible to supply economically the central and northern region of the country by means of an integrated system uniting all the electrical facilities of these regions, which at present are the most important in the in the country.

/The electricity

The electricity demand in the City of Belize has been assumed to grow at a rate of 10 per cent (compounded) which corresponds to the observed growth of cities in Central America with similar characteristics of development and of energy supply conditions (San Pedro Sula in Honduras, Quezaltenango in Guatemala, Leon and Granada in Nicaragua, and David in Panama).

The potential electricity demand in the towns of Corazal, Orange Walk, El Cayo, Benque Viejo, Middle sex, Pomona and Stann Creek, has been estimated as equal to 50 per cent of the capacity and energy demand for the City of Belize, which for the year of 1963 resulted in a per capita demand of 28 watts and 125 kWh. The growth in energy consumption based on an adequate supply of electricity at reasonable prices was estimated also at 10 per cent (compounded). According to the proposed programme those towns should have 24 hour service from 1966 on.

The isolated industrial loads that could eventually be interconnected to the integrated system already mentioned, such as the citrus plants and partly the San Roman Sugar Mill (where sugar cane straw can be used economically for the generation of energy until a better use is found for it) have been estimated to grow at 5 per cent (compounded) which approximately corresponds to the normal growth of these activities. All the aforementioned assumptions are considered rather conservative in relation to the future potential of the British Honduras electricity market. Some of the possible additional loads not included were, firstly the pumping loads for water supply systems (superficial or ground water sources). The implementation of these systems will be more feasible with the proposed electric system. Secondly, industrial loads from new industries to be established in the near future. Thirdly the true existing electricity deficit, inclusive of the City of Belize. This deficit is evidenced by the low average energy consumption per customer of the City of Belize in comparison with other Central American countries (inclusive of rural consumers) notwithstanding the fact that the per capita income is lower in the latter countries (see Tables B and C).

/Table C

Table C

CENTRAL AMERICA AND BRITISH HONDURAS: GROSS PRODUCT PER CAPITA, 1959

Country	Gross product per capita (Dollars, 1960)
Guatemala	262
El Salvador	190
Honduras	196
Nicaragua	220
Costa Rica	385
Central America	240
British Honduras	341

Source: CEPAL, Mexico.

/The results

The results obtained in the power market study for the proposed system are shown on Table 8 of the Annex and give a total of 40,440,000 kWh and 9,350 kW for the year 1975. These values together with those corresponding to other public and private installations give per capita values of 365 kWh of energy production and 94 watts of installed capacity for the year 1975 which corresponds approximately to the equivalent values obtained in Costa Rica in the year 1963. (See Table A.) The rate of growth of the per capita values between 1963 and 1975 would be 97 per cent for generation and 38 per cent for installed capacity which are similar to, or lower than the ones observed in Central America for the period 1950-61 (See Table D). The foregoing shows that the proposed programme is not over ambitious nor out of proportion to the economic and management capacity of Belize.

c) Proposed programme

i) Generation and Transmission. Considering the general characteristics of the hydroelectric potential and of the markets to be served, it appears that the most economical way to supply the electrical necessities of the Central and Northern integrated systems is through the complementation of the hydro and thermal systems. In other words the production of the small hydro-projects which according to the existing data would most likely be run of river with small storages for daily regulation, should be complemented by thermal generation produced at the most important local centres. During the rainy season the hydro plant, would operate at the base of the load curve with the thermal plants generating peak energy for a few areas daily. In the dry season the thermal plants would provide the base load to make up for the deficit in river flow, while the hydro plants, making use of their daily regulating basins, would operate at full capacity on the peak of the demand curve. The hydro plants should be built mostly to displace existing thermal production, that is to say, once there is a ready market for them. This manner of supplying the needs of the electrical markets has already been advantageously used for the central integrated system of Costa Rica, which is the biggest in Central America and the one with the lowest production costs. Similar ideas to those just exposed have been sustained by Belize technicians in the past. (See Appendix A.)

/Table D

Table D

CENTRAL AMERICA AND BRITISH HONDURAS: PERCENTAGE INCREASES OBSERVED IN THE PER CAPITA ANNUAL PRODUCTION AND INSTALLED CAPACITY, 1950-1961

Country	Percentage increases (Annual production per capita)	Percentage increases (Installed capacity per capita)
Guatemala	84,9	83
El Salvador	141,5	132
Honduras	45,3	54
Nicaragua	87,1	42
Costa Rica	57,8	75
Centroamérica	85,6	82
British Honduras[a/]	97,0	38

Source: Naciones Unidas, Estadísticas eléctricas de Centroamérica y Panamá, 1960-1961.

a/ Corresponds to the period 1963-1975.

/For the

For the size of the present and future power market (up to 1975), and the operating conditions already described, the thermal plants more appropriate to complement the hydroelectric plants proposed, are the ones equipped with diesel electric units similar to those existing in the city of Belize, which permit a very flexible operation.

Considering the present status of the evaluation studies for the Vaca Falls hydroelectric project, it is estimated that the earliest possible date for the initiation of its construction would be the year 1969, thus allowing a period four and a half years to make the necessary studies, and the required financial negotiations. The study of the financial alternatives could be started at an early date based on very preliminary figures relative to the cost of the project and its complementary features, equivalent to the ones of an entirely general nature presented in this report.

It does not seem convenient to start the electrical integration of the distant load centres until low cost hydro-power becomes available. As a consequence, no basic interconnections have been programmed in the first few years where only thermal generation is contemplated. On the other hand, small interconnections have been proposed where they can benefit important rural zones, such as Corozal - Orange Walk, El Cayo - Benque Viejo and Stann Creek - Pomona which, in addition, will link the public systems with the private power plants used by some of the most important industrial installations such as San Roman sugar mill and Pomona citrus factories, which in turn will provide a more reliable service with possible reduction in operating costs.

It has been anticipated that the electrical systems presently under the local town boards including the Belize Electricity Board will be transferred to a specialized institution of national scope (National Electricity Board), which would start operations by 1966. By that same year all the towns included in the programme would have 24 hour continuous service provided by means of isolated diesel electric plants. In the year 1972, when the Vaca Falls hydro-project comes into operation, the only other power plant to remain in the integrated system will be the one for the city of Belize. The rest of the diesel units would be moved to other towns in

/the rest

the rest of the country such as Punta Gorda, Mango Creek, Monkey River, San Pedro, Columbia etc., which are not included in the electrification programme proposed in this report. It is probable that the electrification of these areas would follow a similar pattern to the one visualized for the North-Central area, in other words the electricity supply at the beginning would be provided by isolated diesel plants, and at a later stage they could be interconnected to the North-Central system or obtain energy from a nearby hydroproject forming another integrated system. Another possibility would be the construction of the first hydro project to serve the North-Central integrated system on the rivers of the Maya Mountains watersheds, thus facilitating the interconnections with the southern region and of the electrical integration of the entire country. The eventual interconnection of the Belize electric systems with the Matías de Gálvez - Puerto Barrios system in Guatemala and the Chetumal system in Mexico could imply economical and financial advantages to the countries concerned and at the same time provide a greater margin of safety in relation with the quality and continuity of the service to be given.

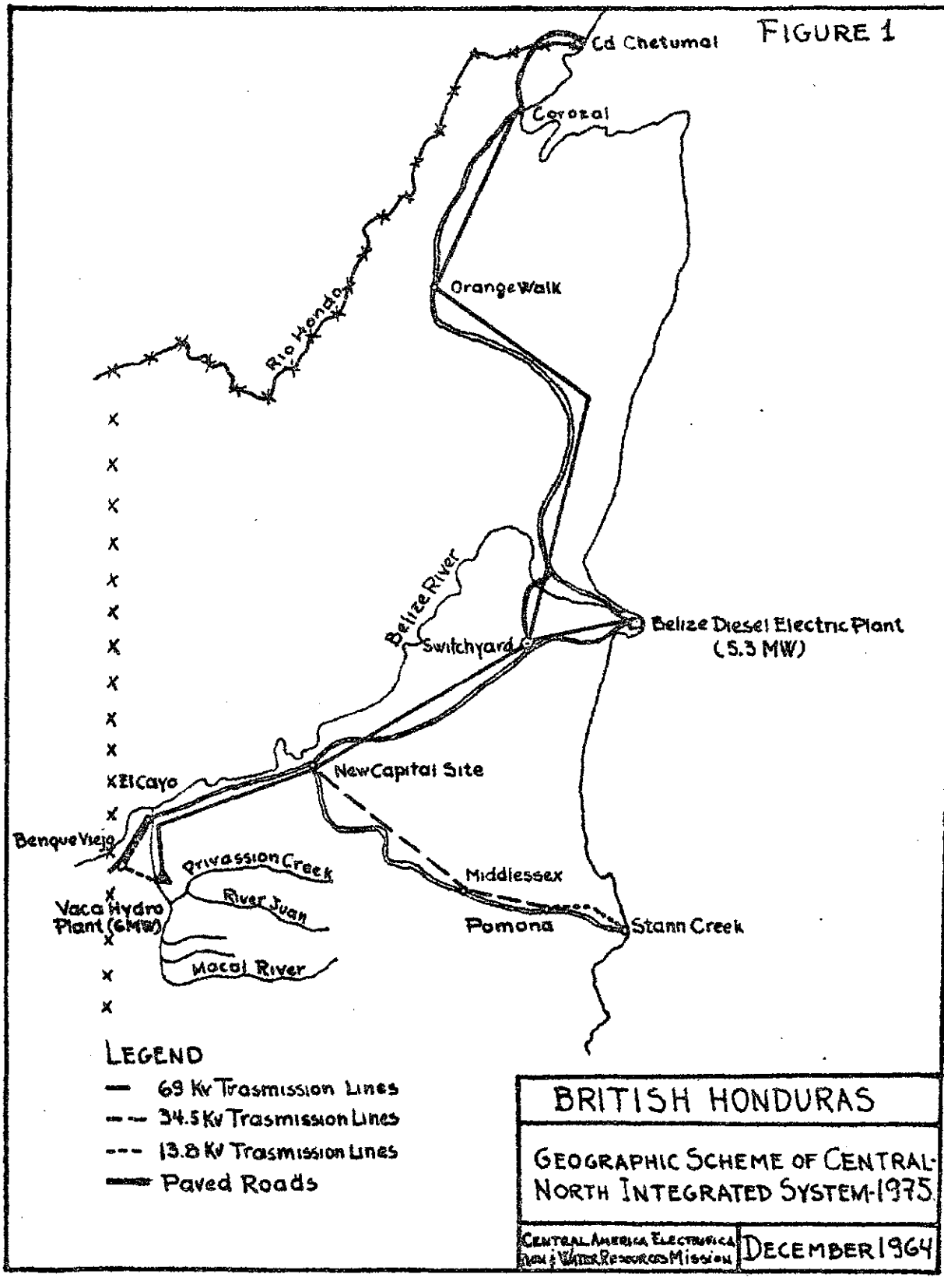
The proposed additions in generation for the period 1964-75 are the following: (see Table 8 of Annex B and Figures 1 and 2).

Belize City. Addition of two 1,000 kW diesel units, in the same location of the existing power plant, the first one to start operating in 1965 and the other one in 1969. Furthermore, one additional diesel unit of 2,000 kW to be placed in operation by 1976.

Corozal. Addition of one 200 kW diesel unit at Corozal in 1966 and a similar one in 1968. Construction of a transmission line between Corozal and Orange Walk and interconnection with the San Roman Sugar Mill in 1966. This line should be insulated for 69 kv as it will become part of the principal transmission system after 1972. However, up to that date it could operate at 13.8 kv. Under this set-up, the Corozal plant would also serve Orange Walk and the nearby rural areas.

El Cayo. Installation of one 100 kW diesel unit in El Cayo and a 13.8 kv subtransmission line between this town and Benque Viejo by 1966. Addition of a similar generating unit and construction of a transmission line to the site of Vaca Falls Hydro project in 1968. This line would be used at the beginning to supply the energy required for the construction activities of the Hydro project and later to carry the Hydro energy to the small towns in that area.

FIGURE 1



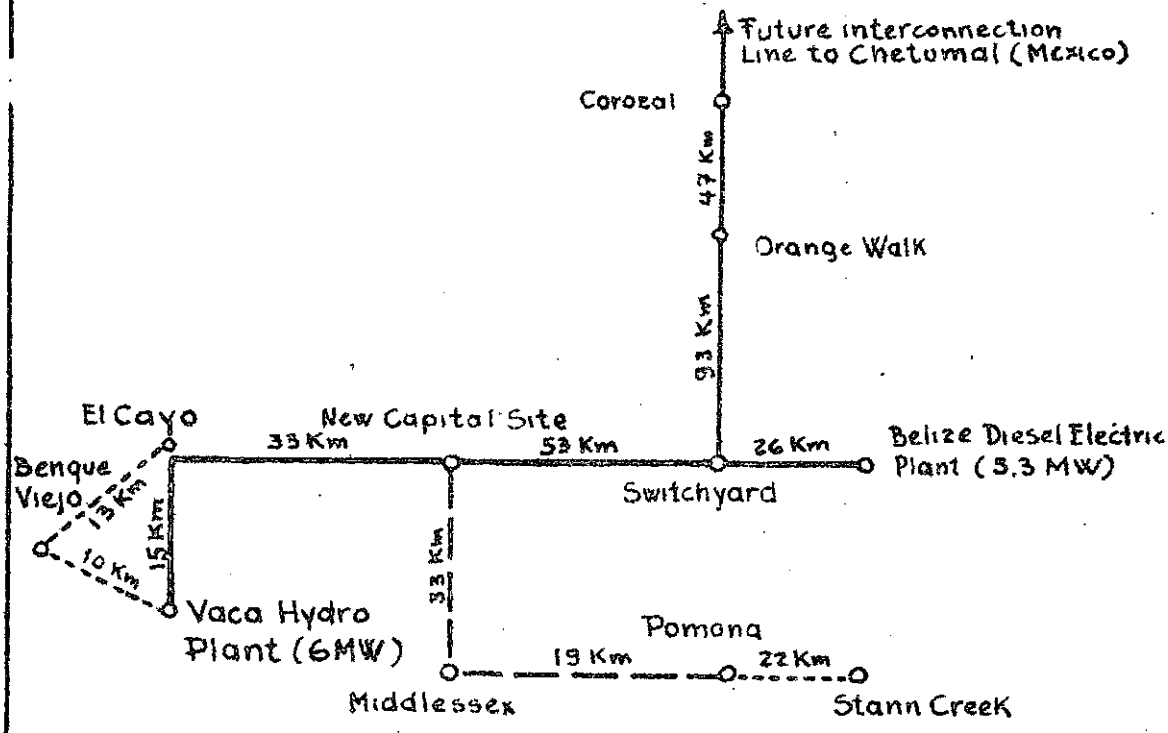
BRITISH HONDURAS

GEOGRAPHIC SCHEME OF CENTRAL-NORTH INTEGRATED SYSTEM-1975

CENTRAL AMERICA ELECTRIFICA[illegible] & WATER RESOURCES MISSION

DECEMBER 1964

FIGURE 2



LEGEND

——— 69 Kv Trasmission Lines

— — 34.5Kv Trasmission Lines

- - - - - 13.8 Kv Trasmission Lines

RESUME

Total	69 Kv Trasmission Lines	267 Km
Total	34.5Kv Trasmission Lines	72 Km
Total	13.8Kv Trasmission Lines	45 Km
	Total	384 Km

BRITISH HONDURAS

SCHEME OF CENTRAL-NORTH ELECTRIC INTEGRATED SYSTEM-1975

CENTRAL AMERICA ELECTRIFICA AND WATER RESOURCES MISSION

DECEMBER 1964

Stann Creek. Installation of a 200 kW diesel unit at Stann Creek, construction of a 13.8 kv subtransmission line to Pomona and interconnection with the power plants of the citrus industries. In this manner the electric service will be available to all the nearby areas.

Mobile Diesel Plant. In order to provide the necessary reserve for the small isolated systems namely Corozal, El Cayo and Stann Creek a mobile diesel unit of 200 kW capacity should be acquired. This unit should be truck-mounted and kept in readiness at all times, thus eliminating the necessity to have reserve units at each one of the locations just mentioned.

Vaca Falls Hydro-project. The construction of the project is to be started in 1969, so as to have it ready for operation in 1972. It will consist of 3 units of 2,000 kW each. In addition the following main transmission lines will be constructed (see Figures 1 and 2) Line Vaca Falls-New Capital site- Belize..... 69 kv
Line to Orange Walk..... 69 kv
Line New Capital site - Pomona..... 34 kv

In this manner by 1972 there will be an integrated system limited at the north by Corozal; at the south by Stann Creek; at the east by Belize City and at the west by Benque Viejo, with electrical energy of similar quality and at the same prices.

The 69 kv transmission voltage chosen for the high tension lines appears to be the most economical in accordance with the electrical development of the region and the transmission distances involved. The subtransmission voltages of 34.5 and 13.8 kv allows direct distribution to the consumers alongside the lines.

ii) Distribution. Construction of up-to-date distribution networks for Corozal, Orange Walk, El Cayo, Benque Viejo and Stann Creek during the year 1965 so as to be ready the following year together with the new diesel electric units. The new distribution system and their extension, as well as those for the city of Belize, should be done at 13.8 kv and the new diesel units should generate directly at this same voltage to save the cost of step-up sub-substations. This voltage makes possible the direct extension of the service to other rural communities within the area with the installations costing nearly the same than for the lower voltages (2.4 and 4.16 kv.)

/The proposed

The proposed investments in distribution do not include extensions outside of the urban areas with the exception of those specifically mentioned.

d) Investment programme. (See Tables 9 and 10 of Annex B).

The total investment required for the period 1964-75 amounts to 9,860,000 dollars subdivided into 3,920,000 for local expenses and 5,940,000 for foreign costs. A subdivision by the main type of investments is as follows:

INVESTMENT PROGRAMME

(Thousands of B.H. dollars)

Type of investment	Total investment	Local expenses	Foreign expenses
Generating plants	5,751	2,546	3,205
Transmission and sub-transmission lines	3,200	962	2,238
Distribution networks	711	214	497
General plant and miscellaneous	198	198	
Total	9,860	3,920	5,940

The value of the total systems (fixed assets) in operation by 1975 will amount to 10,878,000 B.H. dollars, giving a cost per installed kW of 950 B.H. dollars, about 30 per cent of this value corresponding to the main transmission system. The individual investments have been estimated using similar costs already obtained in Central America or previous estimations such as is the case in the Vaca Falls hydro-project.

The most important unit costs used for the estimation of the different works included in the proposed programme are the following:

/UNIT COSTS

UNIT COSTS

	Unity	Cost (B.H. dollars)
Diesel power plants		
1,000-2.000 kW units	kW	286
100-200 kW units	kW	325
200 kW mobile unit	kW	375
Hydroelectric plant (includes step-up substation)	kW	700
Transmission lines		
69 kv	km	7 150
34.5 kv	km	6 430
13.8 kv	km	5 730
Stepdown substation		
69/34.5 - 13.8 kv	kva	28.70
Distribution network		
Belize City	customer	100
Other towns	customer	75

Special attention should be given to the standards of design and construction for the transmission and distribution systems which in the proposed programme have been assumed similar to the ones used by the Rural Electrification Administration in the United States or in Central America by El Salvador and Costa Rica. The erection of the transmission and distribution lines has been assumed to be done using wood poles adequately treated to increase their useful life. If, during the actual implementation of the programme, higher standards were to be chosen for the specifications of the equipment and for the safety factors to be used in the construction and operation of the systems the final costs would be increased beyond the ones justified for an incipient electrification development like the one under consideration with the corresponding reduction in economic benefits. The proposed standards have already demonstrated

/their

their efficiency in countries such as El Salvador and Costa Rica with an industrial development many times bigger than the one foreseeable for Belize in the near future. The failure to use adequate electrical standards in some of the electrification programmes in Central America have been the main cause for the long delays in their actual implementations with negative effects on the economy of the respective regions which were not ready to support an electrical service of the highest quality.

Special care should be taken in the selection of the engineers for the planning and design of the different phases of the programme. They should have considerable experience in developments of similar characteristics and should become familiar with developments of equal magnitude in Central America. All the existing electrical systems in Central America have had to pass through similar stages as the ones under the proposed programme in which considerable investments were required for their extension and consolidation to provide good quality service in extensive regions of their respective countries.

e) Income statement. (See Table 11 of Annex B.)

The economic results can be measured by the figures from the income statement which was prepared for the period 1963-75 under the following assumptions:

i) Creation of an institution (National Electricity Board) responsible for the solution of the electrification problem on a national scale. This organism would take over the Belize Electricity Board as soon as possible and the rest of the governmental systems by 1966.

ii) Extension of the electrical tariffs for the city of Belize to the rest of the isolated towns by 1966. A reduction of 15 per cent in the energy price has been assumed for the period between 1963 and 1975.

iii) Initiation of energy wholesale to the existing industries by 1972 when the Vaca Hydro-project comes into operation. The estimated selling price of 2.5 cents of B.H. dollars is considered adequate to justify the acquisition of energy by those industries that presently have their own power plants. In the case of the San Roman Sugar Mill only the sale of part of their total energy needs is considered as they can continue to produce low cost energy by burning sugar cane straw.

/iv) The operation

iv) The operation and maintenance expenses have been based on the actual costs obtained in other areas under similar conditions. The tax-free fuel cost paid in Belize is approximately 30 per cent higher than in other Central American countries. It has been assumed that these prices will be maintained (18.6 cents B.H. dollars per gallon of diesel oil) during the period under consideration.

v) The isolated diesel-electric plants in the towns of Corozal, El Cayo and Stann Creek would provide 24 hour continuous service by 1966.

vi) The depreciation has been calculated by the straight line system with the following useful lives and annual percentages:

	Useful life years	Annual percentage
New diesel plants	20	5.0
Hydro plant	40	2.5
Transmission lines, substation and distribution networks	25	4.0
General plant	10	10.0

The results show that the return on net fixed assets plus working capital is always positive, reaching the lower values when the high investments come into operation but increasing again in the subsequent years. Considering the relatively high investments required to consolidate the integrated system and the fact that a great deal of the works such as the transmission lines have the capacity to serve the market demands for many years beyond the period used in the report, the results are considered satisfactory. Besides, it is visualized that they would improve considerably in the years immediately following the period under consideration.

f) Financial Statement. (See Tables 12 and 13 of Annex B.)

The financial situation at any time can be determined through the resulting cash flow and forecast of balance sheets from the electrical

/activities

activities of the new national entity for the period 1963-75 which were obtained under the following assumptions:

The investment programme was calculated on the following basis:

i) All the works could be done in the year previous to their entry into operation, with the exception of the Hydro-project, which will take 3 years, and their complementary substations and transmission lines, which will take 2 years.

ii) Adequate loans (in regards to amortization periods and interest) will be obtained to cover the investment programme. In this report the loan conditions have been assumed on a very conservative basis and in accordance with financial possibilities of the institutions. Based on the aforementioned conditions, it was found that total financing of the systems could be accomplished under an increasingly favourable financial position with the following loans:

1) Short-term industrial loans obtained directly from the equipment supplier to cover most of the foreign costs of the diesel-electric units to be installed up to 1968. These loans would cover 80 per cent of the cost of the units with a 6 per cent interest and 5 years for repayment.

2) Medium-term loan (15 years-6 per cent) of 4,193.000 B.H. dollars by 1969 to cover the foreign expenses of the Hydro-project together with its complementary substation and transmission lines. This type of loan is generally easily obtainable from international organizations such as the International Bank for Reconstruction and Development (IBRD) or through special negotiations with industrial groups. Unquestionably the best source for these funds is the IBRD which normally grants better conditions than the ones assumed in this report, which thus improve the financial situation shown in Table 12.

3) Two short-term loans, the first of 200,000 B.H. dollars in 1965 and the second of 2,000.000 B.H. during the years 1969, 1970, 1971 to cover part of the local costs required. These loans have been assumed with a 6 per cent interest and amortization periods of 2 years for the first and 6 for the second. They could be obtained from local commercial banks;

/the sale

the sale of electrification bonds; a loan from an international agency such as the International Development Association of the United Nations, and finally through special loans from the British Government.

4) Industrial loan to finance in identical conditions as in number 1, the addition of a 2,000 kW diesel unit to the power plant in the City of Belize. The necessity to utilize the type of loans proposed constitutes a normal requirement of electrical enterprises which charge reasonable prices for the energy sold.

The estimated internal cash generation (net income plus depreciation) for the period 1963-75 amounts to 6,952,000 B.H. dollars which will be sufficient to cover a good percentage of the prospect investments plus the debt service required by the necessary new investment loans.

These results do not include consideration of the other industrial and commercial activities already mentioned carried out at present by the Belize Electricity Board, and that the national institution will probably continue and extend to the other towns included in the programme. These activities, besides fomenting the consumption of electrical energy will produce additional generation of cash, thus enhancing the financial position of the new institution, which could be of considerable importance at the stage when the programme requires higher investment.

The forecast of balance sheets (see Table 13 of Annex B) shows a very favourable depth equity relation which, in spite of the considerable magnitude of the loans, reaches a value of 50/50 by 1975 and has its lowest point at 63/34 in 1971. The debt service coverage reaches by 1975 a healthy value of 1.4 which is the one generally expected by international lending institutions. The lower values reached in the period 1972-74 reflect the very short repayment periods assumed for the bigger loans which are many times shorter than their useful life terms.

It is convenient to emphasize that the results obtained by 1975 definitely show, that from then on the institution will be in an increasingly better economic and financial position, with the system generating enough funds to cover: a) the local costs of the future expansions and b) the servicing of the loans required for the foreign costs of these same expansions. This stage has already been attained in most of the Central American countries after having passed through financial situations more difficult than the one proposed for British Honduras (Belize).

/4. Recommendations

4. Recommendations for immediate action

The principal recommendations for immediate action relative to the permanent solution of the electricity problem of British Honduras (Belize) can be resumed as follows:

a) The creation of the National Electricity Board responsible for the handling and integral solution of the electrical problem in the entire country and the promotion of the rational utilization of the water resources of the country. This institution should be organized within the criteria for a development type organization and be administered efficiently.

b) The National Electricity Board should prepare a national electrification plan utilizing the hydroelectric potential as the main source of generation whenever economically feasible. This plan would serve to establish the future activities of this entity.

c) Based on the financial necessities of the Electrification Plan just mentioned, preliminary loan negotiations should be started at the earliest possible date. This policy implies a basic change from the criteria followed up to the present, which although it has given satisfactory results for the City of Belize, could constitute, if continued, a severe strain for the electrical development in the immediate future.

British Honduras (Belize) has access to the international institutions which are at present the most favourable sources of credit for governmental public service institutions. The Central American experience in this respect is well defined and points the way to be followed by the new national entity. The lack of timely action in this matter could lead to an unfortunate solution of the electric problem. Up to the present, no country in Central America has managed to make the forward jump equivalent to the one proposed in this report for British Honduras (Belize) without utilizing a high percentage in credits from international lending institutions.

d) The collection of basic hydrological data should be started, at least on the most important river (Macal, Río Juan, Privassion Creek, Belize, Monkey River etc.). It is of the utmost importance that some immediate action be taken in this sense, so as to avoid a repetition of the experience had with previous recommendations. These activities could be

/initiated

initiated jointly by the Belize Electricity Board and the Department of Agriculture, utilizing their present facilities and personnel until the new national electrification entity is created. The cost of the specialized equipment to be obtained at once for the initiation of the stream gauging programme does not exceed the sum of 3,000 B.H. dollars. The river flow measurements proposed are of a very high value since they will provide the first flow data, obtained by direct means on which to start the preliminary planning. It should be borne in mind that the hydrological information would also be of significant value for other water utilization activities such as irrigation, supply of water for human and industrial uses, flood control, etc.

e) The evaluation of specific hydroelectric developments should be started at the earliest possible date and when at least one year of river flow data is available. In order to facilitate the formal initiation of these activities, it would be very convenient to include within the new electrification organism a Planning Department fully staffed with qualified personnel. This Department could start working from the beginning on the collection of the basic hydrological data and the realization of the required surveys in the most promising sites. This information would prove of utmost value for the definite feasible studies to be completed before final negotiation, to obtain loan from international institutions, can be started. Due to the lack of qualified personnel in British Honduras (Belize) and the requirements of the lending institutions in this respect, it would be necessary to use foreign technicians to make the required studies. It would also be necessary to provide an adequate network of hydrological and hydrometereological stations. In this latter respect it would prove advantageous to request assistance from the United Nations Special Fund, which could cover all the foreign expenses of the aforementioned studies leaving British Honduras (Belize) to cover only the local expenses. Another possibility to be explored is the technical assistance that could be obtained from other, more developed, friendly countries.

/f) The Belize

f) The Belize Electricity Board should initiate contacts with the electrification institutions of several other countries so as to be able to profit by some of their valuable experiences, especially in the selection of the more adequate electrification standards. To leave this matter exclusively in the hands of foreign consultants with no intimate knowledge of the region's economic and other conditions, could result in a programme out of proportion which would hinder the future development of the electrification.

g) The organizational establishment of the new entity should follow the best practices already proven in similar types of institutions, and in this respect the preparation of personnel for key positions is of urgent necessity. There seems to be presently a lack of qualified electrical, as well as civil engineers in this field of activity in British Honduras, (Belize). The great number of existing facilities for the training of personnel abroad should be fully utilized.

5. Participation of British Honduras(Belize) in the Central American Electrification and Water Resources Sub-Committee

The pattern of electrical development proposed in this report corresponds in general terms to stages already overcome in many of the electrical systems operating in the Central American countries. For the above-mentioned reasons the new electrification entity proposed for British Honduras (Belize) could profit greatly by its close association with the Central American Sub-Committee of Electrification and Water Resources which groups all the national electrification institutions and the principal private electrical enterprises that operate in the region which, according to past experience, would be glad to make their know-how available to the new entity.

This Sub-Committee is one of the specialized groups of the Central American Economic Cooperation Committee, comprising the Ministers of Economy of Central America and Panama, and its main objective is the promotion and coordination of the economic integration of the Central American Isthmus. The Electrification and Water Resources Subcommittee's main activities are aimed at: a) the coordination, on a regional scale, of

/the national

the national electrification programmes, in order to guarantee the adequate supply of electric energy required for the different programmes of economic integration; b) The gradual elimination of the existing differences in the energy prices charged to the individual consumers, and in the quality of service; and c) the necessary orientation for the optimum utilization of the valuable water resources for the production of energy in Central America.

The work programme of the afore-mentioned Sub-Committee, which is carried out with the technical assistance of the Central American Electrification and Water Resources Mission of the Bureau of Technical Assistance Operations (BTAO) of the United Nations, includes the following principal aspects:

a) Technical assistance to the respective countries in the preparation of their National Electrification Programmes and in the evaluation of their water resources. Work of this type has already been done in Guatemala and Panama and will be done for Nicaragua and Honduras next year.

b) Evaluation of the possibilities of regional electrical interconnections and of combined development of the natural resources for the production of energy. In this respect it is estimated that within 10-20 years there will be a totally integrated system all the way from Guatemala to Panama. The advantages of the combined developments are so great, as is evidenced by studies already made, that it is expected they will be implemented shortly.

c) An overall evaluation, on a regional basis, of the water resources has been started with the aid of the United Nations' Special Fund. This evaluation is aimed at defining the role to be assumed by these resources in the economic development of the region and it includes the following phases: i) Completion of adequate networks of hydrometric and hydrometeorological installations, together with a comprehensive study of the hydrology and related meteorology pertinent to the evaluation of specific projects; ii) Elaboration of basic topographical and general geological maps of the areas with more apparent possibilities for the development of water resources utilization projects in the foreseeable future; and iii) General evaluation of the water resources potential with special emphasis on specific project studies on selected waterheads of regional interest.

/The first

The first phase has been formally submitted to the Special Fund by the six countries of the Central American Isthmus. The second phase will be presented to the Special Fund next year, and the third will be initiated by the Electrification Mission also next year, with the cooperation of additional experts in that field. This study will serve as a basis for additional requests of financial assistance to the Special Fund for pre-investment type studies of specific projects or in the case of the countries that have their own financial means, to give them the pertinent orientation to proceed with the more advanced studies:

d) Preparation of standards for design, construction and operation of electric systems.

e) Promotion for the improvement of the technical and administrative efficiency of the public electrical enterprises in the region. This work includes comparative studies of production costs; comparative analysis of statistics of production and investments; promotion of the utilization of uniform systems of accounting and modern management practices, etc. If the new electrification organism proposed for British Honduras (Belize) could participate in the activities of the Sub-Committee that have been just summarily described, it would benefit greatly especially in the i) initial stages of development and ii) the water resources evaluation. In relation with the hydrological network, project already presented to the Special Fund, it would be necessary to take action immediately if the participation of British Honduras (Belize) is desired. With respect to the activities under a) and b) British Honduras (Belize) could obtain (once in the Sub-Committee) the technical assistance of the Electrification Mission already mentioned which, along with its other activities, could evaluate the possibilities of interconnection in the North with Chetumal in Mexico and in the south with the system that will supply Matias de Galvez - Puerto Barrios and the north coast of Honduras. Furthermore, British Honduras (Belize) could take advantage of the facilities for on-the-job training of local personnel (management, technical, administrative) that could be obtained from the other countries members of the Sub-Committee and especially of El Salvador and Costa Rica.

/Finally

Finally, special emphasis is made on the necessity of a basic change of criteria in the handling of the national electrical problem and the urgency to establish the required means and mechanism to make possible the jump abroad in this important element of infrastructure for the benefit of the economical development of the country.

Annex A

COMMENTS OF MR. M. E. ROBINSON SUPERINTENDENT OF THE ELECTRICITY BOARD OF THE CITY OF BELIZE TO MR. WALKER'S RECOMMENDATIONS

/Our present

Our present market for power and possible short term development, certainly would not justify the capital expenditure that would be involved in the erection of a hydro-electric station. As much as it is true that the operating cost of a hydro-generating station is lower than that of a diesel, thermal or nuclear station, it is also the most expensive as regards the cost per kilowatt of installed capacity for conventional generating stations (a nuclear station is not classified as conventional).

Furthermore, since there are no heavy industrial consumers within a relatively short distance from the possible hydro sites, and the electrical energy consumption per head of our present scattered small population is quite small, it is doubtful whether the revenue from the sale of electricity would be adequate to even repay the capital expenditure that would be required for the design and erection of extra high voltage lines to connect the source of generation to mayor points of utilisation.

In keeping with what will likely be our development pattern, diesel and thermo-electric stations with the eventual interconnection of these should precede the building of a hydro station.

This method of power development will provide us with a national grid with all its advantages at the most economical capital cost, and should al least reduce the transmission cost of energy generated by a hydro station which should not be designed and erected prior to the accumulation of adequate measurements from a hydrometric survey as recommended by Mr. Walker in his report.

The erection of a hydro station does not mean that other stations in existence at the time must become obsolete, on the contrary, such stations will enable us to plan our hydro requirements more economically. During their life span, the diesel stations with their superior loading ability from a cold condition will always be required during their life span for peak loading in accordance with their figure of merit.

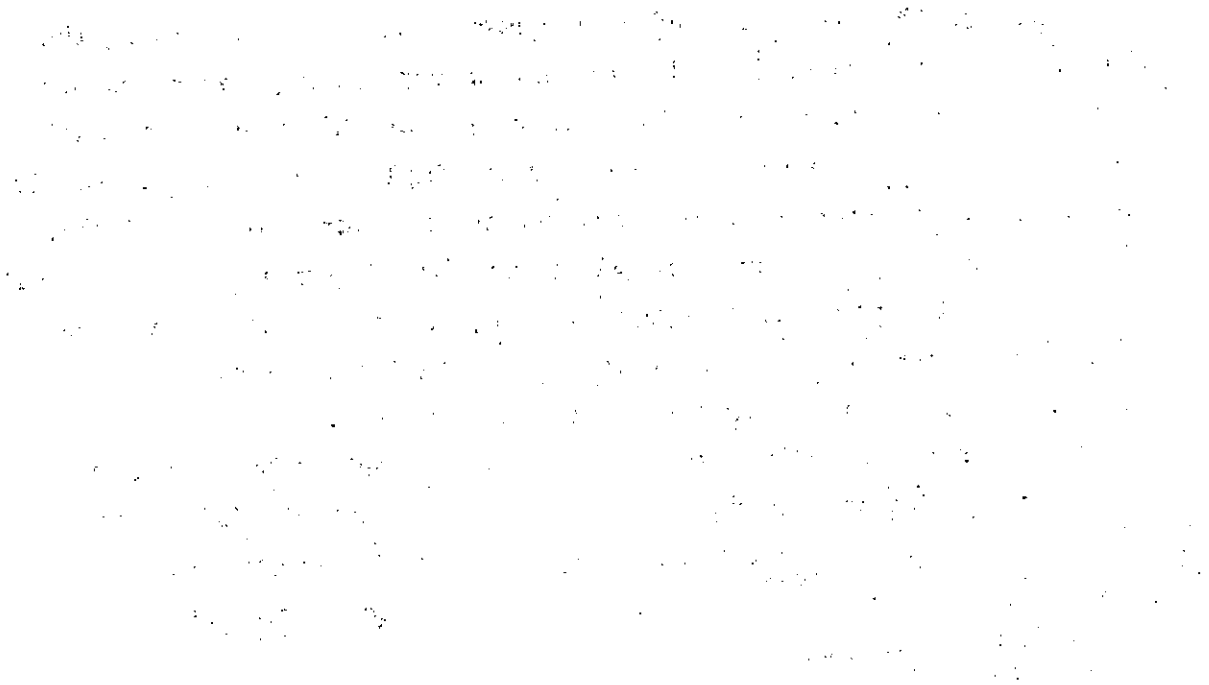
Generation of electrical energy by thermo-electric stations certainly merit more consideration than it has been given to date, and the necessary survey should be carried out now to determine the economical feasibility of this form of generation.

/ Because

Because of the high standard of accuracy required in obtaining the desired data for the economical development of our water power resources, it is essential for the officer placed in charge of this work to be fully conversant with the nature of the work and its implications, and he should preferable be an experienced power engineer in the hydro electric field.

From my observation during my visit with Mr. Walker to the areas that have some potential for a small hydro station, there is apparently some scope for development on a small scale that would likely serve a small community, and these sites merit further consideration.

In conclusion, I would like to record my support of Mr. Walker's view that we have in British Honduras a substantial potential for hydro-power in terms of the present and foreseeable demands, and we should implement his recommendations that would enable us to develop our hydro resources on the most economical basis.



Annex B

TABLES

/Table 1

Table 1

BRITISH HONDURAS: INSTALLED CAPACITY. ELECTRICAL PUBLIC UTILITIES, MARCH 1964

	Town	Installed capacity (kW)	Type of plant	Number of units	Population a/	Installed Capacity (Watts per capita)
1.	Belize	3,320	Diesel	3-850	36,900	90
2.	Corozal	100	Diesel	2-50	3,600	28
3.	Orange Walk	45	Diesel	1-45	2,400	19
4.	El Cayo	67	Diesel	1-67	2,200	30
5.	Stann Creek	30	Diesel	1-30	5,900	5
6.	Punta Gorda	40	Diesel	1-40	2,000	20
Total		3,602			53,000	68

Source: Belize Electricity Board.

a/ Estimated by Central American Electrification and Water Resources Mission up to January, 1964.

/Table 2

Table 2

BRITISH HONDURAS: PRODUCTION OF ELECTRIC ENERGY, ELECTRICAL PUBLIC UTILITIES, 1963 a/

Town	Production (kWh)	Type of service (Hours per day)
1. Belize	9,211,000	24
2. Corozal	175,000	6
3. Orange Walk	76,000	6
4. El Cayo	117,000	6
5. Stann Creek	56,000	6
6. Punta Gorda	88,000	6
Total	9,723,000	

Source: Belize Electricity Board.
a/ Partially estimated.

/Table 3

Table 3

BRITISH HONDURAS: INSTALLED CAPACITY AND PRODUCTION.
PRIVATE POWER PLANTS, 1963

Name of Installation	Installed Capacity (kW)	Type of Plant a/	Number of Units	Annual Production (kWh)
1. Corozal Sugar-Mill	2,400	S-D	S-2-1,000 D-2 200	5,900,000
2. Pomona Citrus Plant No. 1	410	S-D	S-1- 260 D-3- 50	1,600,000
3. Pomona Citrus Plant No. 2	225	D	3- 75	860,000
4. Resin Factory (Mango Creek)	150	D	2- 75	260,000
Total	3,185			8,620,000

Source: Belize Electricity Board, factories and estimates of Central American Electrification and Water Resources Mission.

a/ S-Steam, D-Diesel.

/Table 4

Table 4

BRITISH HONDURAS: TYPICAL MONTHLY BILLS IN THE CITY OF BELIZE

Monthly Consumption	Monthly Bill (British Honduras Dollars)	Average Price per kWh	
		Cents of British Honduras Dollars	Cents of U. S. Dollars
Domestic Purpose			
50 a/	5.60	11.20	7.83
100 b/	9.60	9.60	6.72
200 c/	16.00	8.00	5.59
300 c/	22.00	7.34	5.14
400 d/	27.00	6.75	4.72
500 d/	31.00	6.20	4.34
Industrial and Commercial Purpose			
200	17.00	8.50	5.95
500	33.20	6.65	4.65
1,000	58.20	5.82	4.07
2,000	108.20	5.41	3.78
5,000	208.20	5.17	3.62
10,000	481.40	4.81	3.36

Source: Belize Electricity Board.
a/ Assumed size of house 250 square feet.
b/ Assumed size of house 500 square feet.
c/ Assumed size of house 1,000 square feet.
d/ Assumed size of house 1,500 square feet.

/Table 5

Table 5

BRITISH HONDURAS: BELIZE ELECTRICITY BOARD 1963 INCOME STATEMENT [a/]

Item		B.H. dollars
Revenues		
1. Total energy generation (kWh)	9,211,000	
2. Retail energy sales (kWh)	8,100,000	
3. Average revenue (cents per kWh)	6.82	
4. Revenue from retail sales of energy	552,000	
Expenditures		
5. Generation costs		182,000
6. Distribution costs		68,000
7. Administrative costs		48,000
8. Depreciation (4.56 per cent of fixed assets in operation)		72,800
Generation plant	45,400	
Distribution plant	26,000	
General plant	1,400	
9. Sub-total up to depreciation		370,800
10. Gross income (4-9)		181,200
11. Fixed assets in operation		1 590,000
12. Accumulated depreciation		220,000
13. Net fixed assets in operation (11-12)		1 370,000
14. Working capital		100,000
15. Immobilized fixed assets (13+14)		1 470,000
16. Return on immobilized fixed assets $\left(\frac{10}{15} \times 100\right)$		12.32 per cent

Source: Belize Electricity Board and estimates of Central American Electrification Mission.

a/ Partially estimated.

/Table 6

Table 6

BRITISH HONDURAS: BELIZE DIESEL ELECTRIC GENERATING PLANT. MONTHLY AND TYPICAL DAILY VARIATIONS OF PRODUCTION, 1963

Monthly Variations		Typical daily variations	
Month	Production (Thousand kWh)	Hour	Local (kW)
January	690	0	860
February	620	1	780
March	717	2	760
April	718	3	740
May	755	4	740
June	758	5	780
July	800	6	940
August	858	7	1,050
September	837	8	1,120
October	840	9	1,240
November	803	10	1,200
December	815	11	1,200
Total	9,211	12	1,200
		13	1,080
		14	1,120
		15	1,160
		16	1,180
Maximum annual demand = 2,050 kW		17	1,060
Annual load factor = 51 per cent		18	1,170
Daily load factor typical week day = 63 per cent		19	1,950
		20	1,890
		21	1,725
		22	1,500
		23	1,100
		24	940
			29,485

Source: Belize Electricity Board.

/Table 7.

Table 7

BRITISH HONDURAS: RAINFALL DATA COLLECTED BY THE DEPARTMENT OF AGRICULTURE

Stations	Ten-year annual average up to 1963 (inches)
Corozal town	47.97
Louisville	51.78
Central Farm (Cayo)	61.70
Argentine Pine Ridge	64.54
Norland	62.67
Stanley Field	67.87
Stann Creek Agstat	85.52
Pomona	94.98
Middlesex	104.64
Punta Gorda	162.01
Agstat Toledo	148.63

Source: British Honduras Gazette, February 29, 1964

/Table 8

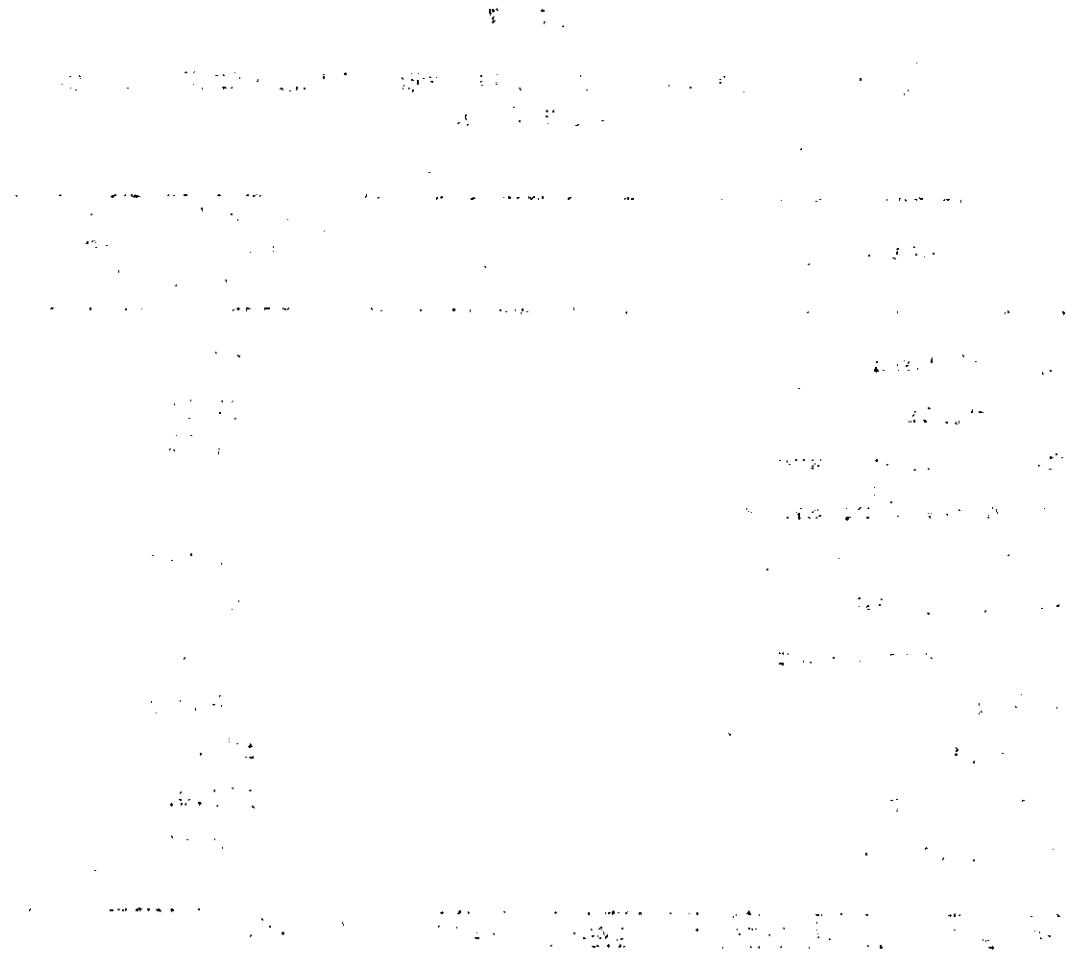


Table 8

BRITISH HONDURAS: POWER REQUIREMENTS AND INSTALLED CAPACITY, 1966-1975[a/]

Central and North Integrated System

Item	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
A. Power Market													
Production required (thousand kWh)				18,455	20,095	21,970	23,980	26,120	28,500	31,040	33,720	37,030	40,440
1. Belize City	9,211	10,100	11,100	12,200	13,400	14,800	16,300	17,900	19,700	21,600	23,600	26,200	28,800
2. Corozal and Orange Walk	750	820	900	990	1,090	1,200	1,320	1,450	1,600	1,760	1,920	2,100	2,320
3. El Cayo and Benque Viejo	400	440	490	530	580	640	700	770	840	920	1,010	1,100	1,200
4. Stann Creek and Pomona	740	815	895	985	1,085	1,190	1,310	1,440	1,580	1,740	1,920	2,110	2,320
5. Citrus Factories	2,460	2,560	2,700	2,830	2,970	3,120	3,280	3,440	3,610	3,790	3,980	4,170	4,380
6. Sugar Mill (San Roman)	800	840	880	920	970	1,020	1,070	1,120	1,170	1,230	1,290	1,350	1,420
Maximum demand (kW)				3,290	3,615	3,990	4,375	4,820	5,305	7,210	7,840	8,580	9,350
1. Belize City	2,050	2,260	2,480	2,730	3,000	3,300	3,630	4,000	4,400	4,850	5,300	5,850	6,420
2. Corozal and Orange Walk [b/]	170	185	200	225	245	270	295	325	360	395	430	480	520
3. El Cayo and Benque Viejo [b/]	90	100	110	120	130	145	160	175	190	210	235	255	280
4. Stann Creek, Pomona & Middlesex [b/]	165	180	200	215	240	275	290	320	355	450	495	545	605
5. Citrus Factories [c/]	(550)	(580)	(605)	(635)	(665)	(700)	(735)	(770)	(810)	850	890	940	985
6. Sugar Mill (San Roman) [c/]	(300)	(315)	(330)	(345)	(365)	(883)	(400)	(420)	(440)	465	490	510	540
B. Installed Capacity and Generation													
Installed capacity (kW)				5,315	5,315	5,615	6,615	6,615	6,615	11,320	11,320	11,320	11,320
1. Belize Diesel Plant	3,320	3,320	4,320	4,320	4,320	4,320	5,320	5,320	5,320	5,320	5,320	5,320	5,320
2. Corozal Diesel Plant [d/]	50	50	50	250	250	450	450	450	450	–	–	–	–
3. El Cayo Diesel Plant [d/]	15	15	15	415	415	415	415	415	415	–	–	–	–
4. Stann Creek Diesel Plant [d/]	30	30	30	130	130	230	230	230	230	–	–	–	–
5. Mobile Diesel Plant	–	–	–	200	200	200	200	200	200	–	–	–	–
6. Vaca Hydro Plant	–	–	–	–	–	–	–	–	–	6,000	6,000	6,000	6,000
Generation (Thousand kWh)	9,211	10,100	11,100	18,455	20,095	21,970	23,980	26,120	28,500	31,040	33,720	37,030	40,440
1. Diesel	9,211	10,100	11,100	18,455	20,095	21,970	23,980	26,120	28,500	5,040	5,120	5,220	5,440
2. Hydro	–	–	–	–	–	–	–	–	–	26,000	28,600	31,800	35,000

a/ Expected date of installation of National Electricity Board 1/12/1965. Assumed starting date for 24 hours' service in small towns 1/1/1966

b/ The demands shown correspond to the theoretical case of irrestricted supply and 24 hours' service which are not expected to become real until 1966.

c/ Citrus and sugar mill factories are not expected to buy any power from Government system until 1972.

d/ Existing plants have been rated at 50 per cent of nominal capacity.

/Table 9

Table 9

BRITISH HONDURAS: INVESTMENT PROGRAMME 1964-1975

Central and North Integrated System

(Thousand B.H. Dollars)

Item	Characteristics	Commission date	Total investment	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
1. Corporation			5,751	-	286	306	-	101	286	1,250	1,700	1,250	-	-	-	572
Addition to Belize City diesel Plant	(4MW)	1965,69 & 76	1,144	-	286	-	-	-	286	-	-	-	-	-	-	572
Addition to Corozal Diesel Plant	(0.4MW)	1966 & 1968	130	-	-	65	-	65	-	-	-	-	-	-	-	-
Addition to Stann Creek diesel Plant	(0.4MW)	1966	130	-	-	130	-	-	-	-	-	-	-	-	-	-
Addition to El Cayo diesel Plant	(0.2MW)	1966 & 1968	72	-	-	36	-	36	-	-	-	-	-	-	-	-
Mobile diesel Plant	(0.2MW)	1966	75	-	-	75	-	-	-	-	-	-	-	-	-	-
Vaca hydroelectric Plant a/	(6.0MW)	1972	4,200	-	-	-	-	-	-	1,250	1,700	1,250	-	-	-	-
2. Transmission lines and substations			3,200	-	-	536	-	-	57	-	900	1,707	-	-	-	-
T.L. Corozal-Orange Walk b/	47 km, 69 kv	1966	336	-	-	336	-	-	-	-	-	-	-	-	-	-
T.L. Pomona-Stann Creek	22 km, 13.8 kv	1966	126	-	-	126	-	-	-	-	-	-	-	-	-	-
T.L. El Cayo-Benque Viejo	13 km, 13.8 kv	1966	74	-	-	74	-	-	-	-	-	-	-	-	-	-
T.L. Benque Viejo-Vaca hidro Plant	10 km, 13.8 kv	1969	57	-	-	-	-	-	57	-	-	-	-	-	-	-
T.L. Vaca hydro Plant - Belize	127 km, 69 kv	1972	906	-	-	-	-	-	-	-	400	506	-	-	-	-
T.L. Switchyard - Orange Walk	93 km, 69 kv	1972	662	-	-	-	-	-	-	-	300	362	-	-	-	-
T.L. New Capital Site - Pomona	72 km, 34.5 kv		462	-	-	-	-	-	-	-	200	262	-	-	-	-
Subtotal transmission lines			2,623	-	-	536	-	-	57	-	900	1,130	-	-	-	-
Step down Substation Belize	7.5 MVA 69/13.8 kv	1972	200	-	-	-	-	-	-	-	-	200				
Step down Substation Corozal	2.5 MVA 69/13.8 kv	1972	75	-	-	-	-	-	-	-	-	75				
Step down Substation Orange Walk	2.5 MVA 69/13.8 kv	1972	75	-	-	-	-	-	-	-	-	75				
Step down Substation Pomona	2.5 MVA 34.5-13.8 kv	1972	75	-	-	-	-	-	-	-	-	75				
Step down SubSwitchyard New Capital	2.5 MVA 69/34.5-13.8 kv	1972														
Switchyard (outlet line to Corozal)	69/kv	1972	75	-	-	-	-	-	-	-	-	75				
Subtotal Substations			77	-	-	-	-	-	-	-	-	77				
			577	-	-	-	-	-	-	-	-	577				
3. Distribution networks			711	-	21	237	33	35	37	40	43	46	49	53	57	60
Belize City-Extensions and Improvements			351	-	21	22	23	24	25	27	29	31	33	36	39	41
Small Towns			360	-	-	215	10	11	12	13	14	15	16	17	18	19
4. General Plant and other investments			198	-	11	12	13	14	15	16	17	18	19	20	21	22
5. Total Investment Programme (1964-1975)			9,860	-	318	1,091	46	150	395	1,306	2,660	3,021	68	73	78	654
6. Fixed assets in operation (end of year)			10,878	1,590	1,622	1,942	3,045	3,094	3,247	3,646	3,706	3,770	10,645	10,718	10,796	10,878

a/ Includes step up substation.

b/ This line will operate at a voltage of 13.8 kv until 1972.

/Table 10

Table 10

BRITISH HONDURAS: DETAIL OF INVESTMENT PROGRAMME 1964-1975

Central and North Integrated System

(Thousand B. H. Dollars)

Item	Totals	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Generation	5,751	286	306	-	101	286	1,250	1,700	1,250	-	-	-	572
Local expenditures	2,546	86	71	-	31	86	625	850	625	-	-	-	172
Foreign Expenditures	3,205	200	235	-	70	200	625	850	625	-	-	-	400
Transmission lines and substations	3,200	-	536	-	-	57	-	900	1,707	-	-	-	-
Local expenditures	962	-	161	-	-	17	-	270	514	-	-	-	-
Foreign expenditures	2,238	-	375	-	-	40	-	630	1,193	-	-	-	-
Distribution networks	711	21	237	33	35	37	40	43	46	49	53	57	60
Local expenditures	214	6	72	10	10	11	12	13	14	15	16	17	18
Foreign expenditures	497	15	165	23	25	26	28	30	32	34	37	40	42
General plant and other investment	198	11	12	13	14	15	16	17	18	19	20	21	22
Local expenditure	198	11	12	13	14	15	16	17	18	19	20	21	22
Foreign expenditure	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	9,860	318	1,091	46	150	395	1,306	2,660	3,021	68	73	78	654
Local expenditures	3,920	103	316	23	55	129	653	1,150	1,171	34	36	38	212
Foreign expenditures	5,940	215	775	23	95	266	653	1,510	1,850	34	37	40	442

/Table 11

Table 11

BRITISH HONDURAS: INCOME STATEMENT, 1963-1975

Central and North Integrated System

(Thousand B. H. dollars)

Item	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
							Revenues						
1. Retail sales													
1. Belize City (Thousand kWh)	8,100	8,800	9,660	10,600	11,630	12,860	14,200	15,550	17,140	18,800	20,500	22,800	25,000
2. Small towns (Thousand kWh)	-	-	-	2,180	2,400	640	2,900	3,180	3,500	3,850	4,220	4,620	5,080
3. Total retail sales (Thousand kWh)	8,100	8,800	9,660	12,780	14,030	15,500	17,100	18,730	20,640	22,650	24,720	27,420	30,080
4. Average income per kWh (cents of B.H. dollars)	6.82	6.75	6.68	6.61	6.54	6.47	6.40	6.33	6.26	6.19	6.12	6.05	5.98
5. Total income retail sales	552	594	645	845	916	1,000	1,092	1,182	1,292	1,403	1,512	1,657	1,794
2. Wholesales													
1. Citrus factories (Thousand kWh)	-	-	-	-	-	-	-	-	-	3,220	3,380	3,540	3,730
2. Sugar mill (Thousand kWh)	-	-	-	-	-	-	-	-	-	1,042	1,100	1,145	1,210
3. Total wholesales (Thousand kWh)	-	-	-	-	-	-	-	-	-	4,262	4,480	4,685	4,940
4. Average income per kWh (cents of B. H. dollars)	-	-	-	-	-	-	-	-	-	2.50	2.50	2.50	2.50
5. Total wholesales	-	-	-	-	-	-	-	-	-	106	112	117	123
3. Total of electric revenues (1.5 + 2.5)	552	594	645	702	761	834	910	987	1,292	1,509	1,624	1,774	1,817

/4. Operation.

Table 11 (continuation)

Item	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
						Expenditures							
4. Operation and maintenance	250	271	303	487	522	563	622	664	716	476	490	504	522
1. Generation	182	201	231	343	373	409	463	499	544	203	208	212	218
Belize diesel plant	182	201	231	252	273	297	337	366	397	153	158	162	168
Small towns' diesel plants	-	-	-	91	100	112	123	133	147	-	-	-	-
Vaca hydro project	-	-	-	-	-	-	-	-	-	50	50	50	50
2. Transmission and substations	-	-	-	40	41	42	43	44	45	140	143	146	149
3. Distribution	68	70	72	104	108	112	116	121	127	133	139	146	155
Belize city network	68	70	72	74	77	80	83	86	90	94	98	102	107
Small town networks	-	-	-	30	31	32	33	35	37	39	41	44	48
5. General and administrative expenses	48	50	52	75	77	80	83	86	90	94	98	102	107
6. Depreciation	73	75	91	142	144	153	173	177	181	394	398	400	403
1. Existing facilities	73	73	73	73	73	73	73	73	73	73	73	73	73
2. New diesel plants	-	-	14	31	31	37	51	51	51	51	51	51	51
3. New transmissions and substations	-	-	-	22	22	22	24	24	24	128	128	128	128
4. New distribution networks	-	1	2	12	13	15	17	19	21	23	25	27	29
5. Vaca hydro project	-	-	-	-	-	-	-	-	-	105	105	105	105
6. New general plant and others	-	1	2	4	5	6	8	10	12	14	16	16	17
7. Total expenditures (4 + 5 + 6)	371	396	446	704	743	796	878	927	987	964	986	1,006	1,032
8. Net income (3 - 7)	181	198	199	141	173	204	214	255	305	439	526	651	762
9. Fixed assets in operation	1,590	1,622	1,942	3,045	3,094	3,247	3,646	3,706	3,770	10,645	10,718	10,796	10,878

/10. Accumulated

Table 11 (conclusion)

Item	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
10. Accumulated depreciation	220	295	386	528	672	825	998	1,175	1,356	1,750	2,148	2,548	2,951
11. Net fixed assets (9 - 10)	1,370	1,327	1,256	2,517	2,422	2,422	2,648	2,531	2,414	8,895	8,570	8,248	7,927
12. Working capital	100	110	120	130	140	150	160	170	180	190	200	210	220
13. Net fixed assets plus working capital (11 + 12)	1,470	1,437	1,376	2,647	2,562	2,572	2,808	2,701	2,594	9,185	8,770	8,458	8,147
14. Net income as percentage of net fixed assets plus working capital (8/13) x 100)	12.32	13.78	14.42	5.32	6.75	7.94	7.62	9.45	11.75	4.77	6.00	7.70	9.37

/Table 12

Table 12

BRITISH HONDURAS: CASH FLOW 1963-1975

Central and North Integrated System

(Thousand B.H. Dollars)

Item	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
						Inflow							
1. Net income sales of energy	181	198	199	141	173	204	214	255	305	439	526	651	762
2. Depreciation	73	75	91	142	144	153	173	177	381	394	398	400	403
3. Total internal cash generation (1+2)	254	273	290	283	317	357	387	432	486	733	924	1 051	1 165
4. Loans to be negotiated	-	160	389	-	54	160	975	2 450	2 768	-	-	-	320
Industrial loan No. 1	-	160	189	-	54	160	-	-	-	-	-	-	-
Medium term loan (15 years)	-	-	-	-	-	-	625	1 750	1 818	-	-	-	-
Short term loans No. 1 and No. 2	-	-	200	-	-	-	350	700	950	-	-	-	-
Industrial loan No. 2	-	-		-	-	-				-	-	-	320
5. Total Inflow (3+4)	254	433	679	283	371	517	1 362	2 882	3 254	733	924	1 051	1 485
						Outflow							
6. Investment Programme	-	318	1 091	46	150	395	1 306	2 660	3 021	68	73	78	654
Local expenditures	-	103	316	23	55	129	653	1 150	1 171	34	36	38	212
Foreign expenditures	-	215	775	23	95	266	653	1 510	1 850	34	37	40	442
7. Debt service (Interest and amortization) a/	-	-	38	85	195	216	134	96	51	889	876	838	838
8. Industrial loan No. 1	-	-	38	85	83	96	134	96	51	51	38	-	-
Medium term loans	-	-	-	-	-	-	-	-	-	432	432	432	432
Short term loans No. 1 and No. 2	-	-	-	-	112	120	-	-	-	406	406	406	406
Industrial loan No. 2	-	-	-	-	-	-	-	-	-	-	-	-	-
8. Total outflow	-	318	1 129	131	345	611	1 440	2 916	3 072	957	949	916	1 492
9. Annual Balance	254	115	(450)	162	26	(94)	(78)	(34)	182	(234)	(25)	135	(7)
10. Cash beginning of year	160	414	529	124	286	312	218	140	106	288	54	29	164
11. Cash end of year	414	529	124	286	312	218	140	106	288	54	29	164	157

a/ Interest during construction included as a part of the investment programme.

Table 13

BRITISH HONDURAS: FORECAST OF BALANCE SHEETS

Central and North Integrated System

(Thousand B.H. Dollars)

Item	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
						End of the year							
Assets	1,784	2,142	2,437	2,803	2,835	2,983	4,038	6,487	9,509	8,949	8,599	8,412	8,656
Fixed assets in operation	1,590	1,622	1,942	3,045	3,094	3,247	3,646	3,706	3,770	10,645	10,718	10,796	10,878
Less: Depreciation	220	295	386	528	672	825	998	1,175	1,356	1,750	2,148	2,548	2,951
Net fixed assets in operation	1,370	1,327	1,256	2,517	2,422	2,422	2,648	2,531	2,414	8,895	8,570	8,248	7,927
Work in progress													
Total net fixed investment	-	286	1,057	-	101	343	1,250	3,850	6,807	-	-	-	572
Current and other assets	414	529	124	286	312	218	140	106	288	54	29	164	157
Liabilities	1,784	2,142	2,437	2,803	2,835	2,983	4,038	6,487	9,509	8,649	8,599	8,412	8,656
Capital and surplus	1,784	1,982	1,916	2,334	2,479	2,671	2,855	2,937	3,235	2,994	3,499	3,862	4,269
Debt	-	160	521	469	356	312	1,183	3,550	6,274	5,655	5,100	4,550	4,387
Financial Ratios													
Debt/Equity ratio	00%	7/93	22/78	17/83	14/86	10/90	29/71	55/45	66/34	65/35	59/41	54/46	51/49
Debt service coverage													
Internal cash generation	254	273	290	283	317	357	387	432	486	733	924	1,051	1,165
Debt service a/	-	-	38	85	195	216	134	96	51	889	876	838	838
Times covered	-	-	7.6	3,3	1.6	1.7	2,9	4.5	9.5	0,8	1.1	1.3	1.4

a/ Interest during construction charged directly to works, not included in debt service.