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PROJECT REPORT

GUATEMALA

CHIXOY RIVER PUEBLO VIEJO HYDROELECTRIC PROJECT





## GUATEMALA

### CHIXOY RIVER PUEBLO VIEJO HYDROELECTRIC PROJECT

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## I. BACKGROUND AND FRAME OF REFERENCE

### A. Background of the Operation

#### 1. The Application

- 1.01 On February 2, 1975 the Minister of Public Finance of Guatemala presented to the Bank an application for a loan to assist in financing Guatemala's 1975-1985 plan for electric energy development, the main project of which is the construction of a hydroelectric power plant at the place named Pueblo Viejo on the Chixoy River.

The government reformulated the application on April 18, 1975 and proposed to the international organizations a scheme for financing the plan, including the Pueblo Viejo, and Aguacapa hydroelectric projects and the Moyuta geothermal electric project, as well as for financing the studies resulting from the 1985-2000 Master Plan, now being prepared by Guatemala with the assistance of the Federal Republic of Germany.

The Pueblo Viejo project is the first stage in the coordinated development of the Chixoy River Basin, to accomplish which the Government has requested of the Bank nonreimbursable technical cooperation to identify possibilities for developing the basin, making use in part of the hydraulic works to be placed in the middle course of the Chixoy River. These works will consolidate the development of the whole service area.

To that end, a coordinated regional development program would be prepared. It would be based on the development of the basin's water resources and include a survey of the area's development potential in agriculture, industry, services and manpower. Furthermore, it would define the necessary infrastructure. The project area is mainly rural, with a population of limited economic means.

- 1.02 A high-level mission, headed by the Secretary of State himself, visited Washington at the end of April 1975. Further details of the Plan were furnished the international organizations during the mission's stay.
- 1.03 The Management of the Bank on July 1, 1975 submitted to the Board of Executive Directors the corresponding memorandum of consultation, abiding by the instructions on the procedure to be employed in cases calling for IDB financing together with other international financial institutions. On occasion of this consultation a tentative scheme of financing was offered, which was developed on the basis of conversations held by the Bank with the High Level Mission and with the executives and technicians of the IBRD and the CABEL.



It was proposed that the prospective Bank loan for Chixoy should be earmarked mainly to finance the lots of project work-measures comprising the headrace: the power tunnel, including the siphon, the surge tank, penstock (pressure feeder pipe) and power house. All this work is to be let for bids at the beginning of 1976 and construction started at the end of 1976, in accordance with the time-schedule of investments.

The IBRD loan for the project would be used for the construction of the dam, procurement of the hydraulic equipment and the transmission system, the lots whereof would be let for bids during 1977 and 1978. The CABEI has been financing the geologic studies and the access works (roads) to Chixoy since the beginning of 1975.

The rest, including the electromechanical equipment that would be let for bids in mid-1976, would be financed through supplier credit, the local contribution and commercial banking credit, on such terms and conditions as would be satisfactory to the IDB and the IBRD.

- 1.04 Since April 1975 technicians of the IBRD and the IDB have worked together in analyzing this project in all its aspects, so that its technical, financial and economic feasibility may be determined on the same calculation bases. The government expects to enter upon definitive negotiations with the IBRD during 1976 concerning the Pueblo Viejo and Aguacapa operations. Therefore, the contracts should be ready for signing at the end of 1976, provided the loans have been approved by the Executive Directors of the World Bank and in keeping with the financial needs as set forth in the investments schedule of INDE and the Government of Guatemala. This schedule calls for (i) inviting bids for the hydromechanical equipment at the beginning of 1977 and for starting manufacturing of the equipment by the end of 1977 and starting construction of the dam by the end of 1978; and (iii) inviting bids for the transmission system in mid-1978 for manufacturing it in 1979.
- 1.05 Since mid-year 1975, the Minister of Public Finance of Guatemala has been holding conversations with various commercial banks in the United States of America and in Europe aimed at obtaining direct loans in order to (i) finance part of the electromechanical equipment, in the event that credit from export organizations is not obtained on favorable terms and conditions; or (ii) to finance part of the local counterpart in the event such credit is offered on reasonable terms and conditions. Accordingly, the Bank, together with the authorities of Guatemala, would undertake at the beginning of 1976 to obtain declarations of intent from export lending organizations in order to finance this equipment, the invitations for bids whereof should be started in mid-1976 and its manufacture during 1977, according to the project investment schedule. 1/

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1/ Appendixes C and D set forth the dates for inviting bids and starting the project work.



## 2. Missions

- 1.06 At the end of 1974, during examination of the operation proposed herein, the Bank took part in an orientation mission and later on, in August 1975, in an appraisal mission that visited Guatemala.
- 1.07 The National Council of Economic Planning, in November 1974, requested short-term technical assistance of the Bank to help prepare the 1975-1985 Energy Development Plan, which includes, among other projects, the Chixoy, Aguacapa and Moyuta projects. The technical report of the expert engaged for the purpose, Engineer Eugenio Salazar, was received at the Bank in April 1975. This report made it possible to make the demand projections of the INDE program, draw up the schedule for execution of the main projects and the tentative cost and financing thereof.
- 1.08 A special IDB mission visited Guatemala in March 1975. During the course of the mission officials of the Operations Department were able to discuss with the Minister of Finance of Guatemala the main aspects of the operation, including those having to do with (i) its prospective financing by international organizations, private banks, and suppliers; and (ii) the possibility of counting on assistance from the Venezuelan Trust Fund held by the Bank, and on funds associated with the long-term option of the oil facility.
- 1.09 A special mission visited Guatemala in September 1975. It was composed of the engineer on the Project Committee and an engineering geologist engaged by the Bank. Its purpose was to verify the geologic aspects of the tunnel, 26 kms long, that forms part of the project. It was thus possible to closely estimate the costs and to examine the chief technical aspects of the tunnel construction; all of this information has been weighed in demonstrating the project's feasibility.

## 3. Priority

- 1.10 The Government of Guatemala has declared the financing of the Chixoy River hydroelectric project to be high in the order of priorities. This was restated on occasion of a meeting between the President of the Republic and the President of the IDB, which was held in December 1974, and on occasion of the visit by the IDB Executive Vice President to Guatemala in May 1975; and once again at the latest meeting of the CEPICIES Subcommittee on Guatemala.

### B. Frame of Reference of the Sector

#### 1. Background Information on Guatemala's Electric Sector

- 1.11 The provision of electricity as a public service was introduced in Guatemala at the end of the last century and it developed in most uncertain fashion up to the beginning of the 1920's. Since, through 1971, the electric energy supply was in the hands of a private institution, the Empresa Eléctrica de Guatemala (EEGSA).

By Decree of Congress 1287 of 1959, the Instituto Nacional de Electricidad (INDE) was created as an autonomous agency of the government, charged with the expansion and operation of electric systems in Guatemala. The INDE started to operate at the beginning of 1961.



The government in 1972 acquired control of the EEGSA, buying most of its shares and services through 1977, that is, five years beyond the expiration of the original term, which was 50 years. This additional term will allow the government time to plan the reorganization of the electric sector so as to consolidate the action of both institutions.

## 2. Organization of the sector

- 1.12 The electric service is now being provided virtually in its entirety (98%) by the INDE and by its major purchaser EEGSA, who have merged their generating facilities into a single entity now named the National Interconnected System.

Generation under this system is for the most part in the hands of the INDE, whereas the distribution is in the hands of EEGSA, which accounts for most (95%) of the customers, buying for these purposes 85% of INDE's energy generation.

- 1.13 The area of Guatemala served by electricity has been divided for administrative and operating purposes into the following systems:

- Central System (SC)
- Eastern System
- Western System
- Atlantic System (SA)
- Separate systems

The first of these is the most important one in Guatemala, comprising the market of the capital city, and is served mainly by the EEGSA with self-generated electricity (35%) and block energy purchased from the INDE (65%). At the end of 1974 it was connected to the Western and Eastern Systems. The Atlantic System serves the population of Puerto Barrios and riparian areas. The separate systems serve small towns, that are too far from the interconnected system and have to be served by city-owned as well as private generating plants.

About 215,000 customers are located in these areas. Capacity and per capita consumption are on the order of 44 W and 152 Kwh a year figures well below the Latin American average.

## 3. Generating capacity

- 1.14 The Guatemalan electric system is supplied by power plants having an installed capacity of 225 MW at the end of 1974, divided, by sources of generation, as shown below:

(In Megawatts)

	<u>Hydro</u>	<u>Steam</u>	<u>Gas</u>	<u>Diesel</u>	<u>Total</u>	<u>%</u>
INDE	96	33	25	7	161	71
EEGSA	-	30	13	9	52	23
Other 1/	6	-	-	6	12	6
Total	<u>102</u>	<u>63</u>	<u>38</u>	<u>22</u>	<u>225</u>	<u>100</u>
Percentage	(45)	(28)	(17)	(10)	(100)	

1/ These are city-owned and privately-owned facilities.



- 1.15 Actual electric energy generation at the end of 1974 was as follows:

(In Gigawatt-hours)

	<u>Hydro</u>	<u>Thermal</u>	<u>Total</u>	<u>%</u>
INDE	329	275	604	67
EEGSA	-	280	280	31
Other	<u>10</u>	<u>12</u>	<u>22</u>	<u>2</u>
Total	<u>339</u>	<u>567</u>	<u>906</u>	<u>100</u>
Percentage	(37)	(63)	(100)	

The tables given above show that thermal plants account for a large share of the installed capacity, a share which becomes even higher if gross generation is considered, since almost all hydroelectric power plants operate without multi-year regulation.

#### 4. Sectoral planning

- 1.16 Program planning and development of the generation aspect of the sector is entrusted to the INDE, as provided in its articles of association.

In order to supply the expected demand in the next decade INDE had to draw up an accelerated program 1/ that calls entirely for thermal power in the first few years and in the last five-year period for the setting in operation of two hydroelectric plants: Aguacapa and Pueblo Viejo, the evaluation whereof is the object of this document.

- 1.17 The situation described in the foregoing paragraphs points out the problem of the Guatemalan electric sector: the large share of thermal generation with the attendant high costs for the INDE and for the country as a whole, since Guatemala must import virtually all its fuel.

Hence, INDE needs urgently to develop new sources of hydroelectric generation and, to that end, in 1972 it undertook to make studies of possibilities for hydroelectric developments. These studies led to the selection of the Pueblo Viejo project, evaluated ahead, which would allow Guatemala to reduce substantially its thermal generation.

To proceed with the later stages of its energy development program, the INDE is now examining, with assistance from the Federal Republic of Germany, a long-term master development plan to provide for the comprehensive development of Guatemala's water resources. 2/

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1/ This program is described in detail in paragraph 1.22.

2/ The characteristics of this study and the advance thereof are analyzed in paragraph 4.17.



Accordingly, INDE's plans also call for electric interconnection with neighboring countries, especially El Salvador. The feasibility studies - arrangements for contracting these have been made - would be a major step in furthering this project which is so useful for both countries. True enough, Guatemala may need energy while the Pueblo Viejo project is made ready for operation, and after that the benefit would accrue to El Salvador which might acquire this plant's surplus generation.

#### 5. Market

- 1.18 The National Interconnected System comprises an area measuring about 36,000 km<sup>2</sup> with a population on the order of 3.8 million persons, that is, three fourths of Guatemala's population. It is an area that contains the major cities and the significant industrial development activities.

This area uses virtually all the country's electric output; INDE and EEGSA supply 98% of the electricity. There are some small city-owned and privately-owned electric utility companies which are gradually being absorbed by the National System. 1/

- 1.19 Statistical data on consumption and output of the National Interconnected System in 1968/1975 is given in Appendix F. The annual average growth rates in this table show 9% for EEGSA customers and 13% for the systems supplied directly by INDE and other electric utility companies. It is appropriate to point out that the EEGSA market is basically an urban market, whereas that of the INDE is chiefly rural, that is, in small population centers.
- 1.20 Using similar methodologies that were based on past trends, analyzed in comparison with the demographic and economic growth of Guatemala, as indicated by the gross product, cost of living index and electric rates level, the demand projections were done at different times by different consultants and by technicians of the INDE.
- 1.21 For purposes of the equipment plan the projections done in April 1975 by the consultant engaged by the Bank, Engineer Eugenio Salazar, were adopted for use in this document. These are similar to those projected for the INDE in the first five years of the projections, whereas in the second period they are more conservative, showing a growth rate of 10% per annum which is more consistent with the past historical trends.

The consultant's figures are increased as of 1982, the year in which the Pueblo Viejo plant would enter service. It is felt that an abundant supply of hydroelectric energy will stabilize the rates with the

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1/ Paragraphs 1.13 et seq examine in detail the structure of consumption of the National Interconnected System.



attendant increase in demand that, as of that year, could increase at the rate of 11% a year. Following are the projections adopted for system generation and demand:

	<u>Demand Projections</u>										
	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>
Maximum demand (MW)	188	212	233	256	280	307	338	372	414	461	514
Gross output (Gwh)	964	1084	1197	1318	1446	1593	1757	1935	2155	2402	2676

6. Equipment program and energy balances

- 1.22 In order to meet the demand, a development plan was drawn up of the generating facilities to be installed over the next ten years (1975-1985), which is summarized below:

	<u>Installed capacity</u>	<u>Year of entry in service</u>
	<u>MW</u>	
Gas turbine units	50	1976
Steam plant at Escuintla	53	1977
Aguacapa hydroelectric plant	60	1980
Moyuta geothermal electric plant	30	1981
Pueblo Viejo hydroelectric plant	300	1982

- 1.23 Progress in the accomplishment of this program is as follows:

Gas turbine units:	Provision of units and installation thereof recently awarded.
Steam power plant:	Now being installed.
Aguacapa hydroelectric plant:	Definitive studies contracted.
Moyuta geothermal electric plant:	Feasibility study awarded.
Pueblo Viejo hydroelectric plant:	Feasibility study completed. Documents for inviting bids practically finished.

The INDE is now arranging for external financing for the expansion of its system. The expansion will comprise furthermore the necessary transmission and distribution facilities.

Advance on this equipment program through 1982 supports the conclusion that the demand may indeed be met, even though there are a pair



of critical two-year periods in which a deficit might arise or reserve capability would be at minimum (see comments on the energy balance in paragraph 1.26).

- 1.24 Even though the Pueblo Viejo power plant will be the last one to enter service, the INDE has granted priority for the start-up of its construction, since the construction period is a long one, and, furthermore, it is the most well-defined as regards design features.
- 1.25 Since the feasibility of the Moyuta geothermal fields has not yet been demonstrated so as to allow the installation of a turbine group, the INDE has decided to contract the study for the interconnection with El Salvador to allow for meeting the deficit expected to arise in 1981/82 in the event a generating station cannot be installed at Moyuta. This interconnection would furthermore allow for using the capacity and placing the energy surpluses that Guatemala would record when the Pueblo Viejo hydroelectric plant becomes operational.
- 1.26 This program for the development of Guatemala's energy sector would continue to be financed in cooperation with international organizations, as described below:

Financing of the Sectoral Program 1975-1985

(Equivalent in US\$ millions)

<u>Projects</u>	<u>Year to enter service</u>	<u>Total cost</u>	<u>Govern- ment</u>	<u>F i n a n c i n g</u>			<u>Suppliers and com- mercial banks</u>
				<u>IDB</u>	<u>CABEI</u>	<u>IBRD</u>	
1. Gas turbine units	1976	8.8	1.0	-	-	-	7.8
2. Steam plant at Escuintla	1977	21.5	21.5	-	-	-	-
3. Aguacapa hydroelectric plant	1980	59.3	22.6	-	-	36.7	-
4. Moyuta geothermal plant	1981	30.1	9.4	19.4	1.3	-	-
5. Pueblo Viejo hydroelectric plant	1982	340.9	130.1	105.0	5.4	65.0	35.4
Total		460.6	184.6	124.4	6.7	101.7	43.2
Percentage		100.0	40.0	27.0	1.5	22.1	9.4



Energy and capacity balances

- 1.27 Appendixes G and H give the balances for the 1975-85 period, which are described separately as follows:

a. Energy balance

- 1.28 The comparison is based on firm energy in a period (year) of adverse water conditions for hydroelectric power production and a period of medium water conditions when secondary energy must be added owing to the greater head at the hydroelectric plants.

Examination of this balance shows that if there is a period of adverse water conditions in 1975-76 and 1980-81, there would be a deficit or a very small surplus of firm energy such as might require forced outage.

As soon as the Pueblo Viejo hydroelectric plant becomes operational, there is a large energy surplus which declines gradually as consumption increases. This surplus could be used to replace virtually all thermal generation or use it for export to some neighboring countries, such as El Salvador, in the event the intertie is warranted and arrangements are made for it. This course of action would also be advantageous in that it would supply the prospective deficits in 1980-1981.

b. Capacity balance

- 1.29 The situation as regards capacity is very similar to that of the energy balance described above, although any deficit likely to occur would be somewhat out of phase with respect to that of energy.

Furthermore, the capacity to be added to the system by the Chixoy plant will yield a surplus capacity for three years through 1985 at which time the recommended reserve margin of 20% will have been reached. Accordingly, steps should be taken to provide for setting in operation a peak load plant in the following year since there would still be an adequate energy surplus.

- 1.30 It is appropriate to note the fact, as a conclusion of the examination of these balances, that the INDE generation system will need a plant to become operational in 1982; otherwise, in the years thereafter there would energy and power deficits. The best alternative is the Pueblo Viejo hydroelectric plant, since it is the only project of this kind that is now so well-defined as to allow its construction to begin as soon as the process of inviting bids is finished.

7. Previous Loans from International Organizations

- 1.31 The IDB in 1963 granted INDE Loan 81/OC, equivalent to US\$3.1 million, to assist in the construction of the Los Esclavos hydroelectric plant



(13 MW) and its transmission line to Guatemala City, at a total cost of US\$5.1 million equivalent. Disbursement of the loan, the objectives whereof were met, ended on June 18, 1966.

- 1.32 In 1967 and 1968 the IBRD approved two loans to Guatemala for a total amount of US\$22 million equivalent for the purpose of assisting in the accomplishment of Guatemala's electric development program, through the installation of the Jurún-Marinalá hydroelectric project (60 MW) and the Escuintla steam generating plant. These facilities were finished and are now operating satisfactorily. The IBRD will continue to participate in financing INDE's hydroelectric projects, especially Pueblo Viejo and Aguacapa.
- 1.33 The USAID in 1971 granted a loan of US\$7 million equivalent for rural electrification.
- 1.34 The CABEI in November 1974 approved loans of US\$7.8 million equivalent to assist in the construction of preliminary works for this project (equivalent to US\$5.4 million) and complementary geologic studies to the Pueblo Viejo feasibility report.

#### 8. National Importance of Project

- 1.35 The electric power sector, especially the Pueblo Viejo hydroelectric project, is of national importance for socioeconomic development in Guatemala. The project has top priority under government policy and will benefit a wide spectrum of users, sectors and regions. Execution of the Pueblo Viejo project is the cheapest way of meeting the increasing larger electric energy demand associated with sustained economic growth.
- 1.36 The project was designed in accord with the aims of the 1975-79 development plan and is a prerequisite to the 7.5 per year economic growth needed for achieving the central goal of raising the standard of living of all the people. The project will directly further the goals of economic growth, better distribution of income among social classes and regions, reduced dependency of the economy on external factors, savings of foreign exchange, greater price stability through lower production costs, and rational utilization of the country's national resources.
- 1.37 Within the development plan for the energy sector, the Pueblo Viejo project, together with the rural electrification plan and the program for interconnection of power systems, is the decisive element for satisfying the growing demand for energy, developing the country's energy resources in a rational way, optimizing the production of energy, and replacing energy sources based on the use of petroleum and other vegetable fuels.



## II. THE PROJECT

### A. Objectives and Description of the Project

- 2.01 The purpose of the project is to expand the INDE generation system by constructing a hydroelectric plant at an intermediate point along the Chixoy River. The plant will have 300 MW of installed capacity and mean energy generation of 1,650 GWh a year. 1/

The Pueblo Viejo project is the first stage in the coordinated development of the Chixoy River Basin, to accomplish which the Government has requested of the Bank nonreimbursable technical cooperation to identify possibilities for developing the basin, making use in part of the hydraulic works to be placed in the middle course of the Chixoy River. These works will consolidate the development of the whole service area.

To that end, a coordinated regional development program would be prepared. It would be based on the development of the basin's water resources and include a survey of the area's development potential in agriculture, industry, services and manpower. Furthermore, it would define the necessary infrastructure. The project area is mainly rural, with a population of limited economic means.

- 2.02 The project consists of: (i) a rockfill dam at the place named Pueblo Viejo; (ii) a spillway; (iii) a power tunnel (headrace) about 26 kms long; (iv) a plant located at Quixal with a powerhouse of 300 MW capacity; and (v) a transmission line, about 120 kms long, from the power plant to Guatemala City.
- 2.03 The project is located in the center of Guatemala, about 80 kms - as the crow flies - from Guatemala City in a mountainous region with elevations ranging from 300 meters to 3,000 meters.
- 2.04 In the project area itself, the course of the Chixoy River is a large S-shaped meander, about 58 kms long, grading downward about 400 meters. This drop is to be utilized by means of a dam that will provide multi-year storage 2/ of 424 million cubic meters of water, to be located at the upstream end of this double curve at the place named Pueblo Viejo; and a generating plant to be located at the downstream end at the place named Quixal. A power tunnel would be constructed between both structures to convey water over a distance of about 26 kms.
- 2.05 The scheme is shown in Appendix A. It would consist of the following work-measures:

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1/ In paragraph 2.07 these figures are compared with the cost of the project.

2/ This reservoir will provide for regulating 90% of the river's streamflow, likely to be necessary 98% of the time.









B. Borrower

- 2.06 As described in numerous previous legal reports, the Republic of Guatemala is fully empowered to act in the capacity of borrower.

C. Total Cost and Financing Plan of the Project

1. Cost Table

- 2.07 The total cost of the project is estimated at US\$340,874,000 equivalent, as itemized below: 1/

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1/ The project construction cost is itemized in Appendix B.

(Equivalent in thousands of US\$)

<u>Categories</u>	<u>Direct Costs in Foreign Exchange</u>	<u>1/</u>	<u>Costs in Local Currency</u>	<u>Total</u>	<u>%</u>
<b>1. <u>Engineering &amp; Administration</u></b>					
1.1 Engineering and supervision	10,282		2,421	11,703	
1.2 Administration and overhead	-		5,187	5,187	
<b>Total Category 1</b>	<b>10,282</b>		<b>7,608</b>	<b>17,890</b>	<b>5.2</b>
<b>2. <u>Direct Construction Costs</u></b>					
2.1 Lot A (Complementary works)	4,920		10,330	15,250	4.5
2.2 Lot B (Headrace and powerhouse)	49,895		31,114	81,009	23.8
2.3 Lot C (Diversion, dam, spillway)	17,706		10,132	27,838	8.2
2.4 Lot D1 (Mechanical equipment)	12,971		1,414	14,385	4.2
2.5 Lot D2 (Electrical equipment)	12,420		1,380	13,800	4.0
2.6 Lot D3 (Hydraulic equipment)	7,145		820	7,965	2.3
2.7 Lot E (Transmission system)	10,209		1,605	11,814	3.5
<b>Total Category 2</b>	<b>115,266</b>		<b>56,795</b>	<b>172,061</b>	<b>50.5</b>
<b>3. <u>Financing Charges</u></b>					
3.1 Interest on IDB loan	11,724		-	11,724	
3.2 Credit commission & IDB commitment fee	2,408		-	2,408	
3.3 Interest on IBRD loan	13,552		-	13,552	
3.4 Commission on IBRD loan	1,007		-	1,007	
3.5 Interest on CABEI loan	324		-	324	
3.6 Interest on supplier credit	7,091		-	7,091	
3.7 Commission on supplier credit	355		-	355	
3.8 Inspection and supervision fee	900		-	900	
<b>Total Category 3</b>	<b>37,361</b>		<b>-</b>	<b>37,361</b>	<b>11.0</b>
<b>4. <u>Unallocated</u></b>					
4.1 General contingencies	14,463		7,621	22,084	
4.2 Allowance for escalation	63,044		28,434	91,478	
<b>Total Category 4</b>	<b>77,507</b>		<b>36,055</b>	<b>113,562</b>	<b>33.3</b>
<b>Total Cost</b>	<b>240,416</b>		<b>100,458</b>	<b>340,874</b>	<b>100.0</b>
<b>Percentage</b>	<b>70.5</b>		<b>29.5</b>	<b>100.0</b>	

1/ Does not include indirect costs as explained in paragraph 2.13.



It is important to point out that this project, the largest in Central America - including projects now in service as well as those under active consideration - has a cost of US\$1,130 per KW of installed capacity, which may be regarded as high for facilities of this kind. However, the production of 1,650 GWh with a high proportion of firm energy compares favorably in terms of production costs with the costs of thermal generation which, at this time, would be the only equipment alternative available to meet the demand in 1982, the year when the Pueblo Viejo is scheduled for completion. In fact, the generating costs of this project, about US\$26 mills/KWh is 25% below that of equivalent thermal production which would be US\$32.5 mills/KWh.

## 2. Bases of calculation

- 2.08 The determination of the project costs was done using prices prevailing in the middle of 1975, and assuming that, except for the complementary works contracts, 1/ all invitations for bids would be awarded to foreign bidders.
- 2.09 The cost estimate of the civil works was prepared by the consultants and was based on budgets drawn up by specialists in the matter of civil works who work with construction companies and who were independently engaged for the purposes. Special emphasis was placed on such parts of the project as have the largest effect on the direct costs. This criterion was used in calculating thoroughly the unit prices of the power tunnel and the dam; these structures account for 65% of the cost of the civil works.
- The cost of equipment was determined on the basis of pro-forma invoices (quotations) obtained from American and European suppliers.
- 2.10 A review of costs was done at the time the appraisal mission was in Guatemala, it having been found that these, generally speaking, were reasonable and in keeping with those recorded in similar projects. But, in view of the fact that: (i) the size and complexity of the headrace works, the cost whereof is 47% of the direct costs and the period for their execution is along the critical path of the works, and (ii) these would be financed by the Bank, it was thought necessary to engage an expert to review the geologic aspects of these works and undertake a revision of the budget and the period of time allowed for execution.
- 2.11 The Bank engaged an engineering expert in geology and soil mechanics to provide this service: Mr. Andrew Merrit, who is associated with Professor Don Deere, the last-named being a member of several boards

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1/ Construction of access roads, field housing, and land purchases, estimated at US\$15.3 millions.



of consultants that advise on projects financed by the IDB. The report prepared by this expert gives his interpretation of the geology that would be found along the bearing of the tunnel and associated works; the problems that might arise and the influence that these would have on the advance of the excavation work and on the need to provide supporting structures along the rock face.

Thus the IDB technicians were able to reestimate the cost of the headrace works and the time allowed for execution as well. These new estimates assume an 18% increase over the budget prepared by LAMI for the headrace and provide for an extension of 1 year approximately to completion of the project. The increase in costs was weighed in the evaluation given in Chapter IV to demonstrate the project's feasibility.

Engineering and administration (US\$17,890,000 equivalent)

- 2.12 The engineering and supervision costs of this heading amount to US\$11.7 million equivalent and were estimated as a percentage of the direct costs, in the case 7%, which is customary to this kind of project. Included in the costs are fees and expenses payable to the Board of Special Consultants (Junta de Consultores Especiales), whose functions are described in paragraph 2.31. It was assumed in estimating the costs that the Group of Consultants will make an average of 4 to 5 visits a year to the field, either at regular intervals or occasionally.

These trips, including the time allowed for preparing reports, would require about 8 days each. Based on previous experience, it is assumed that each consultant would charge US\$400 a day as fees and receive US\$100/day for per diem and other expenses. The cost of travel fares is estimated at US\$1,000 and the duration of services at 6-1/2 years, the time allowed for construction of the project.

According to these bases the estimate of the costs making up the engineering category is as follows:

Fees	- 4 x 8 days x US\$400 x 30 trips =	US\$384,000
Per diem	- 4 x 8 days x US\$100 x 30 trips =	96,000
Transportation	- 4 x US\$1,000 x 30 trips =	<u>120,000</u>
Total		<u>US\$600,000</u>

The local costs are based on the same assumptions, including the INDE management expenses allocable to this heading.



Direct costs of construction (US\$172,061,000 equivalent)

- 2.13 The external component of the construction costs would consist of the cost of imported materials for the project, the construction machinery and most of the contractor's overhead. <sup>1/</sup> The local costs would consist mainly of national labor and materials as well as the rest of the construction company's overhead. The external cost of equipment is made up of the FOB cost, transportation and marine insurance, as well as supervision of installation. The local component includes ground transportation and installation expenses associated with unskilled labor.

Financing expenses (US\$37,361,000 equivalent)

- 2.14 The estimate of financing expenses is based on the terms and conditions of the several credits contemplated to cover the external costs of the project. The financing expenses associated with the complementary credit line (LCC), which is not included in the project costs, would amount to US\$4,239,000 equivalent and are to be given in the financial projections of the INDE as of 1976.

Unallocated expenses (US\$113,562,000 equivalent)

- 2.15 Allowance for contingencies on civil works were estimated taking into account the complexity and size; the customary margins of tolerance were weighed in making the allowances for equipment contingencies. Thus, the contingency allowance of 20% was taken for the headrace works, 15% for the dam, and 10% for the rest of the civil works; and 5% was taken for equipment and materials. In allowing for escalation, the coefficients established by the technical units of the IDB were taken; these assume a ten per cent annual cumulative increase in foreign exchange for the civil works and of 12% for the equipment. Annual escalation at 10% was taken for national currency.

3. Source and application of funds

- 2.16 The project would be financed with the cooperation of the IDB, the IBRD, the CABEI and other lending organizations. The Bank would use the resources of (i) the FSO, unrestricted; (ii) the Venezuelan Trust Fund (VTF); and (iii) the ordinary capital, through a complementary credit line (LCC).

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<sup>1/</sup> No allowance has been made for indirect costs in foreign exchange since the importation of raw materials for processing is not contemplated and construction machinery is expected to be depreciated entirely during the course of the construction work, given its duration.



(Equivalent in thousands of US\$)

<u>Sources</u>	<u>Source of Funds</u>		<u>Expenses to be paid in</u>		<u>Total</u>	<u>%</u>
	<u>Foreign</u>	<u>Local</u>	<u>Foreign</u>	<u>Local</u>		
<u>IDB Loan</u>						
(i) FSO	45,000	-	45,000	-	45,000	
(ii) VF	45,000	-	45,000	-	45,000	
(iii) LCC	15,000	-	15,000	-	15,000	
Total IDB	105,000	-	105,000	-	105,000	30.8
<u>IBRD Loan</u>	65,000	-	65,000	-	65,000	19.1
<u>CABEI Loan</u>	5,400	-	5,400	-	5,400	1.5
<u>Parallel Financing</u> 1/	35,362	-	35,362	-	35,362	10.4
<u>Local Contribution</u> 2/ and 3/	-	130,112	29,654	100,458	130,112	38.2
Total	210,762	130,112	240,416	100,458	340,874	100.0
Percentages	(61.8)	(38.2)	(70.5)	(29.5)	(100.0)	

4. Investment categories and their financing

2.17 It is estimated that the investments in the project would be financed as follows:

- 1/ Includes supplier financing.  
 2/ Includes regular budget resources of the Government of Guatemala and financing through the long-term option of the petroleum facility arrangement between Guatemala and the Venezuelan Investment Fund.  
 3/ The foreign exchange to be financed by the borrower is broken down as follows:

<u>Headings</u>	<u>Amounts</u> (In thousands of US\$)
Down payment on equipment financed through supplier credits	2,539
Allowance for escalation not contemplated in the loans	15,930
Commissions on the loans	3,770
Interest on loans from CABEI and supplier credit	7,415
Total	29,654



(Equivalent in thousands of US\$ dollars)

Categories	Total	Local Contribution		Foreign Exchange for External Expenses			
		Costs Foreign Exchange	Costs Local Currency	IDB	IBRD	CABEI	Suppliers
<b>1. Engineering &amp; Administration</b>							
1.1 Engineering and Supervision	12,703	-	2,421	10,282	-	-	-
1.2 Administration and Overhead	5,187	-	5,187	-	-	-	-
Total Category 1	17,890	-	7,608	10,282	-	-	-
<b>2. Direct Construction Costs</b>							
2.1 Lot A (Complementary works)	15,250	-	10,330	-	-	4,920	-
2.2 Lot B (Headrace and powerhouse)	81,009	-	31,114	49,895	-	-	-
2.3 Lot C (Diversion, dam, spillway)	27,838	-	10,132	-	17,706	-	-
2.4 Lot D1 (Mechanical equipment)	14,385	1,297	1,414	-	-	-	11,674
2.5 Lot D2 (Electrical equipment)	13,800	1,242	1,380	-	-	-	11,178
2.6 Lot D3 (Hydraulic equipment)	7,965	-	820	-	7,145	-	-
2.7 Lot E (Transmission system)	11,814	-	1,605	-	10,209	-	-
Total Category 2	172,061	2,539	56,795	49,895	35,060	4,920	22,852
<b>3. Financing Charges</b>							
3.1 Interest on IDB loan	11,724	-	-	11,724	-	-	-
3.2 Credit commission & IDB commitment fee	2,408	2,408	-	-	-	-	-
3.3 Interest on IBRD loan	13,552	-	-	-	13,552	-	-
3.4 Commission on IBRD loan	1,007	1,007	-	-	-	-	-
3.5 Interest on CABEI loan	324	324	-	-	-	-	-
3.6 Interest on supplier credit	7,091	7,091	-	-	-	-	-
3.7 Commission on supplier credit	355	355	-	-	-	-	-
3.8 Inspection and supervision fee	900	-	-	900	-	-	-
Total Category 3	37,361	11,185	-	12,624	13,552	-	-
<b>4. Unallocated</b>							
4.1 General contingencies	22,084	-	7,621	9,670	3,524	-	1,269
4.2 Allowance for escalation	91,478	15,930	28,434	22,529	12,864	480	11,241
Total Category 4	113,562	15,930	36,055	32,199	16,388	480	12,510
Total Cost	340,874	29,654	100,458	105,000	65,000	5,400	35,362
Percentage	(100.0)	(8.7)	(29.5)	(30.8)	(19.1)	(1.5)	(10.4)



Terms and conditions and use of IDB resources

2.18 The loan from the IDB, in the amount of up to US\$105 million equivalent to be used in the following manner:

- (i) A loan of US\$45 million equivalent in foreign exchange, chargeable to the unrestricted Fund for Special Operations, to be granted at 1% interest during the grace period and 2% thereafter; credit commission at 0.5%, grace period at 10 years; and amortization period at 40 years.
- (ii) A loan of US\$45 million equivalent in foreign exchange with resources of the Venezuelan Trust Fund, to be granted at 8% annual interest; commitment fee at 1-1/4%; grace period at 6 years and amortization period at 25 years.

These two loans would be used for the procurement of goods and services through international competitive bidding on construction of the headrace works, the powerhouse, and the engineering and supervision of the project.

- (iii) A complementary credit line of US\$15 million equivalent, from the ordinary capital, to be used to finance the down payment required for the headrace works.

Terms and conditions and use of IBRD resources

2.19 The loan from the IBRD, estimated at US\$65 million equivalent, would be used for procurement of goods and services through international competitive bidding for:

- (i) starting construction of the spillway and the dam at the end of 1977 and 1978, respectively;
- (ii) procurement of hydraulic equipment during 1977;
- (iii) equipment and materials for the transmission facilities in 1978.

The IBRD loan, to be granted directly to the Government of Guatemala, would bear interest at 8.5% a year, have a commitment fee of 0.75%, a grace period of 6 years and allow amortization in 15 years.

Terms and conditions and use of resources of CABEI

2.20 The CABEI granted the Government of Guatemala a loan of US\$5.4 million equivalent, to start construction in 1975 of the access works to the project, bearing interest at 8% per annum, having a commitment



fee at 0.75%, a grace period of 5 years and amortization in 15 years. The CABEI financing would be completed through a loan of US\$10 million equivalent to absorb the expected increase in costs of the access works mentioned above, on the same terms and conditions. <sup>1/</sup>

Credit from suppliers and others

- 2.21 Provisions were made for credit from suppliers and other sources <sup>2/</sup> in the amount of US\$35,362,000 equivalent, which would provide for financing 90% of the CIF costs of the electrical and mechanical equipment. For the two procurement operations contemplated, that is, turbines and generators/transformers, it is expected that credit will be obtained allowing grace periods until the equipment is in operation, a 10-year term of amortization as of that period, and interest at about 8% per annum.
- 2.22 The Government of Guatemala has explored with several commercial banks in the United States and Europe the possibility of obtaining direct loans of about US\$30 million to be used to finance part of the equipment, in the event supplier credit is unavailable on favorable terms and conditions, or for the purpose of financing part of the costs allocable to the local contribution if supplier credit is obtained on suitable terms and conditions. The Bank, together with the Guatemalan authorities, will hold conversations in regard to these credits with export financing organizations at the beginning of 1976.
- 2.23 The external component for the project would be financed as follows: (i) the proposed loan from the IDB, entirely in foreign exchange, would cover engineering, headrace works and the powerhouse; (ii) the credit from the IBRD would provide for the dam and spillway, the hydraulic equipment, and the transmission equipment and materials; (iii) supplier credit would be used to finance 90% of the CIF costs of the electromechanical equipment; (iv) loans granted by the CABEI would provide for payment of the access works; (v) the local contribution would cover US\$29,654,000 equivalent of external costs, which amount could be reduced in the manner indicated in the foregoing paragraph.

All the loans would cover: (i) unallocated expenses to the extent that these should not exceed the amounts of the loans; and (ii) the interest during construction, except interest on supplier credit and on credit from the CABEI, which would be drawn on the local contribution.

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<sup>1/</sup> This additional financing is not included at this time in the scheme for financing the project.

<sup>2/</sup> Includes export credit from official entities.



The down payment to contractors for the electromechanical equipment would also be drawn on the local contribution as well as the credit commission and the cost allowances for escalation which were not covered by external credit.

- 2.24 The scheme for financing foreign currency is regarded as adequate, since through borrowing from international banks the costs of the engineering, civil works contracts, and those for such equipment and materials as are not attractive enough to obtain supplier credit, would be covered.

The amount projected for supplier credit is consistent with the conditions usually governing this type of financing. It is felt, furthermore, that the equipment selected for this loan is the best suited for obtaining a loan on reasonable terms and conditions, in light of the considerable sophistication and technology required in its manufacture.

- 2.25 The contract should include appropriate provisions so that before the first disbursement of the loan the Guatemalan Government shall submit, to the Bank's satisfaction, evidence of having obtained letters of intent to finance from suppliers and/or commercial banks such as will allow the complete and continuous execution of the project. 1/

#### Local contribution

- 2.26 The local contribution for financing this project is estimated at US\$130,112,000 equivalent of which amount the equivalent of US\$60,112,000 would be financed with the Government of Guatemala's own resources, and the equivalent of US\$70 million with funds from the long-term lending option of the petroleum facility arrangement between the Government of Guatemala and the Venezuelan Investment Fund.

Furthermore, analysis of the budgetary resources and the provisions in the National Development Plan of the Guatemalan Government supports the prediction that the Government of Guatemala will face no difficulties in providing the local contribution to the project during the time schedule for execution. 2/

#### Use of FSO resources

- 2.27 The use of the Fund for Special Operations is thought to be an adequate course of action to assist in financing the project,

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1/ See draft resolution.

2/ See paragraph 4.07 which gives an analysis of the impact of the local contribution in relation to local resources.



considering that Guatemala is a relatively less developed country and that Central America is one of the regions that has suffered most from the impact of the increase in the price of petroleum. In fact, the increase in the capacity for hydroelectric generation is one of the most important purposes now engaging developing countries, particularly Guatemala, since such a course would entail a substantial saving in resources now being used for the purchase of petroleum-derived fuel used in generating electricity. In this connection the Chixoy project would limit the needs for such fuel imports, the price whereof has been on the increase. The project would thus contribute to relieving the burden of Guatemala's balance of payments, which showed a sizable deficit in 1974 owing to the rise in fuel prices on the world market. The substantial investment called for and the long term allowed for the construction of the project will require a national effort of great magnitude that will necessitate financial support on fairly concessionary terms and conditions.

It is appropriate to point out here that the Puerto Viejo project is the first stage in the comprehensive development of the Chixoy River Basin for which purpose the Government of Guatemala has requested nonreimbursable technical cooperation of the Bank. <sup>1/</sup> This project is aimed at multipurpose development of the Chixoy River streamflow, and its regulation through the Pueblo Viejo reservoir, so as to allow for optimizing the spillover benefits that would obtain in the river basin through the proposed investment. It is fitting to point out that the project service area is predominantly rural and that its population is made up of people of limited means.

#### Use of the unrestricted FSO resources

Pursuant to Document GP-35-1 of September 26, 1975, there is a special advantage in using the unrestricted FSO resources for this loan operation: in addition to their favorable terms and conditions, they may be used in these circumstances to procure goods and services in a geographic area similar to that of the ordinary capital resources and the Venezuelan Trust Fund, providing for the invitation for bids on the headrace works to be financed by the IDB.

Examination of this operation shows that the use of these resources, from the standpoint of price and of the type of goods to be purchased, would substantially benefit this less developed country.

In fact, the Bank's loan was structured after several resource-use alternatives were examined. The alternative proposed herein affords the advantage of lower direct cost, since invitations for bids - made in an unrestricted market, therefore, a more competitive one - would allow the presentation of bids under methods allowing greater

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<sup>1/</sup> An explanation of the features of this technical cooperation is given in paragraph 4.26.



advance in the power tunnel construction. This tunnel, as explained ahead, determines the whole project execution period.

It is expected that about US\$55 million in unrestricted FSO resources will have been accrued by the end of 1977 and continue to accrue thereafter. Likewise, the area of eligibility for procurement of goods and services with FSO resources would be enlarged by the addition of non-regional countries to membership in the Bank, presumably in the middle of next year, and by the entry into effect of the increase in resources, so that this benefit could be extended without restriction to all IDB borrowers. It should be pointed out that the anticipated availabilities are sufficient to meet the needs identified to date for this type of resources.

#### Transfer of resources

- 2.28 The proceeds of the IDB loan for financing this project would be transferred by the government to the INDE on terms and conditions consistent with the provisions of the Agreement on the Transfer of Resources, which is given herein in Appendix T, and which would be entered into by both parties before the first disbursement. <sup>1/</sup> While this operation was undergoing analysis, the government considered the possibility of transferring FSO resources using the two-step scheme so as to allow the INDE to acquire the loan on similar terms and conditions to those governing the Bank's ordinary capital. However, based on the financial analysis, the government concluded that the INDE would be unable to absorb the loan on the harder terms that the two-step procedure would entail.

In fact, the government felt that if the INDE should acquire the loan, from the IDB on harder terms and conditions than those proposed herein, the government itself should make allotments to the INDE of similar amounts so as to prevent any adverse effect on the financial position of the institution. Furthermore, 57% of the IDB loan would consist of resources of the Venezuelan Trust Fund and of the ordinary capital resources. Thus, the average rate for the operation would be very similar to that which the government would have applied to the INDE in the event the two-step procedure were used. Computing the total of external financing on the most likely terms, the average interest would be 5.3%. As regards amortization the average term is 29 years.

#### D. Execution of the Project

##### 1. The executing agency and technical supervision

##### Administrative, technical and operational capabilities

- 2.29 The organization that would be in charge of executing the project, that is, the INDE, has created as part of its organization structure, a unit reporting directly to the General Manager. This unit will be in charge of managing the construction of the Pueblo Viejo hydroelectric facility. Its head will be an Executive Director who will be responsible for three organizational sections: financial, administrative and engineering.

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<sup>1/</sup> See draft resolution.



- 2.30 This last-named section will be assisted and advised by a firm of consultants that INDE shall engage and they will be responsible mainly for the preparation of project designs and technical supervision of the construction work. INDE proposes to engage the LAMI consortium, which is the same organization that did the preliminary studies and prepared the bidding documents. It is felt that this course of action would benefit the development of the project, since it would provide for even greater continuity of engineering services, it being furthermore recommended by the fact of the good work done by these firms during execution of the studies.
- 2.31 In addition, and given the size of this project, it is thought necessary that INDE should have at its disposal technical advisory assistance on project-associated matters of a group of special high-level consultants, in different technical disciplines such as geology, soil mechanics, and hydraulic engineering. This group, together with the INDE, would schedule regular visits to the project site in order to supervise the progress of work on designs and the actual work. It would furthermore take up any specific problems that might arise, recommending suitable measures for the solution thereof.
- 2.32 It is recommended, in conclusion, that before the first disbursement of the prospective loan, INDE should engage the services of an engineering firm and of a group of individual consultants such as will carry out the project engineering work and supervision and advise on technical matters specifically associated with the execution of the project, respectively. 1/ This technical support for the work of the executing unit is regarded as essential for the unit to be in a position to carry out and effectively accomplish the project according to schedule.
- 2.33 The President of INDE will appoint, to the satisfaction of the Bank, the Director of the executing unit, who will engage themselves exclusively with the work of that unit and supervise the staff who will do the actual work associated with the project.

## 2. Machinery of execution

### Status of designs and specifications

- 2.34 The design conception adopted for the works is based on prefeasibility and feasibility studies that were financed by the World Bank and done by the LAMI Consortium of Consultants. It is important to point out that the World Bank is in agreement with the proposed project design and that, on the other hand, its evaluation would be based on the same cost parameters set forth herein, copy whereof would be conveyed to the technical units of the IBRD for these purposes.

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1/ See draft resolution.



The prefeasibility stage, which started in the middle of 1972, consisted of an investigation into the middle course of the Chixoy River in order to develop it for energy generation. The findings of this analysis determined the feasibility of four plants, the sequential optimization whereof led to the selection of the Puerto Viejo project as the one most suited to initiate the development. <sup>1/</sup> Accordingly, at the second stage of feasibility the design features and cost estimates of the hydroelectric plant were determined.

- 2.35 The preparation of the project is regarded as very much advanced, since plans and specifications are now available for inviting bids for all contract items. The only thing now needed is to do the interpretation of the information gathered in the supplementary geological surveys done along the tunnel bearing, in order that the findings of these should be reflected in the bid documents to be furnished the prospective bidders. This stage will be concluded at the end of this year, at which time the proceedings for the prequalification of firms to undertake construction should be under way. It is fitting to point out that the findings of this investigation are now partly known as they were summarized in the preliminary report presented in September 1975, on the basis whereof the expert engaged by the Bank prepared his recommendations.

It is felt, therefore, that the final interpretation would not alter the project costs nor the period allowed for execution since the margin allowed for contingencies (20%) is expected to cover any variations in these parameters.

#### Purchase of land and rights of way

- 2.36 INDE has started to purchase land and to obtain rights of way for the proposed transmission line of the project and for access roads leading to the project sites, which are now under construction. All rights of way for transmission lines would be acquired or be supported by definitive commitments by the end of 1979. No legal nor financial problems concerning this type of operation are anticipated since the National Congress by Decree 59-71 of 1971 declared this project to be an urgent national need, pursuant to Decree 419 of January 1966. Among other matters this legislative act authorizes the INDE to make a deposit in a special account and make use of the land it may need, in the event no immediate arrangements have been made with the owner. Likewise, the INDE has included the amount of US\$200,000 in its 1976 budget for these purposes.

#### Schedule of investments

- 2.37 The period allowed for execution and disbursement of the project would be 6-1/2 years, starting with work on the access roads, scheduled for

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<sup>1/</sup> See paragraph 4.14 of the justification where an explanation is given of this optimization study done by the Bank.



first-quarter 1976, and ending with the setting in operation of the generating units of the power plant in second-quarter 1982. The annual investment schedule, which was established on the basis of the program for inviting bids and the construction schedule, is given in Appendixes C and D and may be summarized as follows: <sup>1/</sup>

	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>Total</u>
IDB	1,889	19,439	15,164	17,093	23,816	22,124	5,475	105,000
IBRD	-	5,261	5,371	17,626	25,912	7,778	3,052	65,000
CABEI	5,400	-	-	-	-	-	-	-
Suppliers	-	1,746	10,710	11,814	8,694	2,398	-	35,362
Borrower	12,237	18,384	11,854	19,070	30,914	30,182	7,471	130,112
Total	19,526	44,830	43,099	65,603	89,336	62,482	15,998	340,876
Percentage	5.7	13.2	12.7	19.2	26.2	18.3	4.7	100.0

It is evident from an examination of the project execution schedule that construction of the headrace works, that is, Lot B to be financed by the Bank, establish the critical path of the project.

How this six and one-half year term was arrived at - it sets the IDB loan disbursement period - is explained ahead. Considering that the invitation for bids would be made at the beginning of 1976, work on the headrace (power tunnel) could be started at the beginning of 1977.

Three excavation sites are contemplated for construction of the tunnel: two at the site of the syphon and the third at the site of the surge tank. The first section, upstream of the syphon, would be 7,809 meters long up to the intake; the other two sections, downstream of the syphon and upstream of the surge tank, would be the longest, measuring 8,950 meters each.

For purposes of estimating the time needed for excavation work, the longest section was taken in which the work would be done in three shifts daily, each of them expected to complete one blasting cycle which under normal conditions, presupposes an advance of about three meters.

Mr. Andrew Meritt, the engineering consultant engaged by the Bank, has estimated that on the basis of the different types of geological formations and hydrologic conditions along this section of the tunnel, the excavation advance could as follows:

Part without metal supports (55% of total length) - 10 meters daily

Part with metal supports (37% of length) - 6 meters daily

<sup>1/</sup> The itemized schedule is given in Appendix E.



Difficult part (water, caves - in 8% of length) 3 meters daily

Taking one of the long sections (8,950 meters) since it is to be worked simultaneously on two faces, the time to excavate the tunnel may be purchased.

4,920 meters/10 meters daily	=	492 days
3,820 meters/6 meters/daily	=	250 days
750 meters/3 meters/daily	=	250 days
8,950 meters		1,288 days
1,288 days/25 days a month	=	<u>52 months</u>

The following unit advances are taken for the work of facing the tunnel in concrete: 200 meters daily for the soleplate and 32 meters daily for the arch.

Therefore, the total time for concrete facing is obtained:

Soleplate:	8,950 meters/200 meters daily	=	45 days
Arch:	8,950 meters/ 32 meters daily	=	<u>280 days</u>
			325 days

325 days/25 days a month = 13 months

Summarizing the estimates, the time anticipated for construction of the tunnel, which marks the project execution period, is determined.

Contracting	=	12 months
Excavation	=	52 months
Concrete facing	=	<u>13 months</u>
Total		75 months

#### Procurement of goods and services

##### a. Procedures

- 2.38 The procedures to be used for inviting bids and making awards, as well as the contracts to be entered into for the procurement of goods and services for the project, will be governed by the provisions of law in effect in Guatemala and the appropriate procedures of the IDB. In the course of the negotiations on this loan operation, the INDE and the Government of Guatemala were informed of the Bank's requirements on contracting of services, procurement of goods, and awarding of contracts for the project, as well as about the policies on margins of preference. Hence, the Minister of Finance on October 27, 1975 submitted, to the satisfaction of the IDB, the procedure to be used in inviting bids for the program. 1/

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1/ This procedure is given in Appendix U.



b. Invitations for bids

If the value of any procurement or contract for the procurement of equipment and machinery or contract work for the project should amount to US\$50,000 equivalent, public invitation for sealed bids will be required. Such procurements as are to be financed wholly or partly with the proceeds of the IDB loan will be let for international bidding. Those to be financed with the local counterpart resources may be restricted to Guatemala.

Invitations for bids for construction work

Before the invitation for public bids and works construction, the INDE will submit to the Bank for its approval the final plans, specifications and cost estimates applicable to the project, as well as the documents for inviting bids. INDE would award the construction contract with the prior approval of the Bank. Public invitations for bids on construction work would be made in the manner prescribed in the preceding paragraph, using the procedure mentioned.

Invitations to bid on equipment, machinery and other goods

The executing agency will invite bids, as provided in the foregoing paragraph, in such a way as to allow proposals to be made by suppliers of national goods and suppliers from eligible member countries of the IMF and Switzerland.

In making awards, analyses of the unit prices, technical specifications of the machinery, equipment and materials and equipment maintenance programs would be taken into consideration. In examining proposals, the executing agency may allow machinery, equipment and materials of local origin a margin of preference consistent with the IDB's pertinent policies.

- 2.39 Contracting for project construction, as regards the civil works for the generation facility, has been divided into three invitations for bids: (i) access roads; (ii) headrace works and power house; and (iii) dam, spillway and diversion. The most important of these three groups, and the one which marks the project execution period, is the group comprising the headrace and power house; as a group it alone accounts for 47% of the direct cost of construction. As regards equipment, plans call for making three invitations for bids: one for turbines, another for generators and transformers, and the third for steel structures (piping, gates, etc.). The transmission system to be let for bids under a turnkey contract would comprise the step-down substation in Guatemala City.
- 2.40 The grouping of invitations for bids - summarized and itemized in Appendix C - provides for uniformity of contracts and for reducing



to a minimum the number thereof so as to facilitate administration of the contract and make their individual amounts as attractive as possible to prospective international bidders. All invitations for bids will be made on this basis.

The first invitation for bids 1/ would be for the group to be financed through the IDB loan and would be made in the first quarter of 1976 so as to start work at the beginning of 1977. Contracts to be financed with World Bank resources would be let for bids at the beginning of 1977 in order that the down payments may be made at the end of this year, coincidental with the date of the granting of this loan, since the duration of such work-measures is much less than those of the power tunnel. However, in order not to delay the draining of the dam construction site, the advisability of proceeding with the construction of the diversion tunnels is being examined, in which case this work would be financed by the borrower.

- 2.41 The timing of the invitation for bids and the principal equipment items to be financed through supplier credit was determined on the basis of an economic comparison between the financing costs of this credit and the escalation in the prices of such equipment. Furthermore, the cash requirements of the executing agency were weighed in order to avoid concentrating down payments on equipment items and the finance charges on this loan in the years when financial obligations (outlays) are greatest.

Past expenses

- 2.42 The schedule of investments given in Appendix E shows that expenses to be incurred in 1976 will be for engineering services required for preparing work drawings and for work on the access roads.

It is expected that before the effective date of the loan contract, expenses will have been incurred of US\$7,500,000 equivalent under these headings. These expenses were made after the date of presentation of the loan application, and now it is requested that an amount equivalent to US\$6,500,000 2/ should be allowed as chargeable to the local contribution, and an amount equivalent to US\$1,000,000 3/ to be charged to the proceeds of the Bank loan. 4/

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1/ The invitation for bids on the access roads (with CABEI resources) and a comparative examination of proposals is now in progress.

2/ Local counterpart for construction of access roads, the external component whereof was financed by the CABEI.

3/ Costs of engineering and supervision that would be paid in that time.

4/ See draft resolution and recommendations.



3. Operation and maintenance

- 2.43 Operation and maintenance of the hydroelectric power plant will be done by the respective department of the INDE, under the direct responsibility of the Generation Section. The Appraisal Mission had the opportunity of visiting the principal plants now in operation and to take note of the maintenance systems employed, having found that these are satisfactory; so it is expected that INDE will encounter no greater difficulties in operating this new plant.

The contract shall contain the usual provisions so that upon completion of the physical work-measures of the project and for 10 years thereafter, all necessary steps will be taken so that the project works will be adequately maintained and sufficient resources for the purpose made available yearly.

- 2.44 As regards plant load dispatching, it is felt that the use now being made of the plants suits the present situation in that the supply of water is very variable, for which reason the reservoirs of the hydroelectric plants now in operation, except for Jurúm-Marinalá, will not allow a constant regulation of stream flows.

It is for this reason that intensive dispatching from thermoelectric plants is now being done; the gas turbine plants in particular are working at plant load factors far greater than usual to this kind of facility.

Once the Pueblo Viejo hydroelectric plant becomes operational the situation would change radically, since this plant alone in its first few years of operation would virtually cover the load pattern, so that the actual dispatching operation will become quite simple.



### III. EXECUTING AGENCY FOR THE PROJECT

#### A. Institutional and Organizational Structure of INDE

##### 1. Background

- 3.01 The executing agency would be the National Institute of Electrification (Instituto Nacional de Electrificación - INDE). Pursuant to Article 1 of the law that created it (Decree 1287 of the Congress of the Republic and amendments thereto - Legislative Decree 1413 and Decree Laws 37 and 195) INDE is a decentralized government agency with functional autonomy, legal personality, assets and full capacity to acquire rights and contract obligations.
- 3.02 The institute acts as a regulatory agency for public electric service in Guatemala. Thus, Article 56 of the law that created INDE stipulates that only INDE and the municipalities can construct, or directly contract for the construction of, new electric plants for public service. The firms which, by virtue of their concessions, are empowered to expand or construct electric power generating plants can only do so with the prior authorization of INDE and that of the Executive Branch.
- 3.03 As a regulatory agency, it is also entrusted with supervising and enforcing compliance with the laws, regulations, ordinances and contracts relating to public electric service.

The Ministry of Communications and Public Works (see Appendix L) is the liaison between the Executive Branch and the institute (Article 54 of the law creating INDE). The institute has an indefinite life.

- 3.04 The organs authority of the institute are the Board of Directors and the Management. The Board of Directors is in charge of general management of the activities of INDE. It is made up of five principal directors and three assistant directors, all appointed by the President of the Republic through the Ministry of Communications and Public Works. The Management is the executive organ of the institute and is in charge of administration and management of the institute pursuant to the decisions made by the Board of Directors. The General Manager acts as Secretary to the Board. The major offices in the institution are listed in the organization chart in Appendix L.
- 3.05 The institute has 1,927 employees in the following areas:



	<u>Profes-</u> <u>sionals</u>	<u>Tech-</u> <u>nicians</u>	<u>Adminis-</u> <u>trative</u>	<u>Unskilled</u>	<u>Total</u>
Administration	70	91	197	126	484
Engineering and construction	20	93	91	158	362
Operation and maintenance	35	570	80	308	993
Marketing and consumer services	1	2	80	5	88
Totals	126	756	448	597	1,927

Source: INDE. Personnel Section.

## 2. Financial and accounting management

- 3.06 The management of the financial resources of INDE is the responsibility of the Administrative Division through its Financial Department which has 79 persons. The latter is responsible for collection and payment of the funds of the institute as well as all matters relating to inspection and general supervision of income and expenditures.

### Accounting and budget system

- 3.07 INDE's accounting is centralized in the main office at Guatemala City, in its Accounting Section. The institute has adopted the Uniform System of Accounts proposed by the Federal Power Commission of the United States for public utilities, adapted to the special conditions of the country.

Processing of accounting information is approximately 60% computer based and 40% machine registered. Payment vouchers are prepared by hand.

The economic and financial system of INDE includes preparation of the annual budget of income and expenditures which is forwarded for consideration by the Ministry of Finance which presents it, with a recommendation, to the Executive Branch for its approval. Budgetary accounting is carried out separately from general accounting and is subject to the rules and nomenclature of the Manual of Budget Classifications which is standard for all government agencies.

### Internal control

- 3.08 The control machinery of INDE shows weaknesses, which were covered by the external auditors in their comments on the evaluation of internal accounting control and caused them to qualify their opinions rendered



in the last few fiscal years. These reservations refer primarily to the impossibility of reconciling the control accounts of the ledger with the balances on auxiliary records for several categories, such as materials and construction supplies, maintenance, import materials in transit and suppliers of materials and equipment. In the opinion of the independent accountants, these shortcomings have been carried forward over the years and make it impossible to determine whether the categories in question are reasonable.

Work is now going on to straighten out these balances.

- 3.09 The Internal Auditing Section does not have a manual of procedures to organize and orient the work of the auditors. The basic work guide is an old instruction manual from the Ministry of Public Finance. Also there is no annual work program describing the activities to be carried out by Internal Auditing in each fiscal year. The audit reports are excessively detailed and narrative.
- 3.10 The above aspects limit the activities of Internal Auditing and its effectiveness as a management control tool, and, therefore, a condition is established for INDE to include advisory services for strengthening its auditing function pursuant to the technical cooperation requested from the United Nations, as described in paragraph 3.46. 1/

#### External control

- 3.11 From the standpoint of external control, the INDE management is subject to inspection by the Office of the Controller of Accounts of the Nation, through a permanent delegation of controllers composed of one chief and five controllers. In addition, INDE is required to present quarterly reports on its activities to the Ministry of Finance (Technical Bureau of the Budget). Furthermore, each year the Board of Directors of INDE contracts a firm of independent public accountants to examine its financial statements, supplementary financial information and compliance with the accounting and financial clauses included in loan contracts with international lending agencies.
- 3.12 Concerning the project under study, the potential borrower will be required to submit to the Bank, within 120 days following the close of each fiscal year, the financial statements of the executing agency (INDE) for the 20 years of the proposed loan, as well as those pertaining to the Chixoy River Hydroelectric Project, during the implementation of the project, these are to be audited by a firm of public accountants acceptable to the Bank.

#### Procurement procedure

- 3.13 Concerning procurement and contracting of construction work, services and supplies by INDE, it is necessary to comply with the provisions

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1/ See Recommendations.



contained in the Law on Procurement and Contracting of Goods, Supplies, Works and Services (Decree 11-71 of the Congress of the Republic); and in the regulations to that law (Government Agreement No. c.n. 9-71 of March 26, 1971). Procurement of goods and services for the project is regulated by the bidding procedure agreed upon by the Bank, as explained in paragraph 5.11 and Appendix U.

- 3.14 Pursuant to Article 21 of its by-laws, the board of directors must authorize all purchases or transfers of real estate, personal property or rights, whenever the value of any of these items exceeds US\$3,000. When the amount is less than US\$3,000, the operation must be authorized by the General Manager. This situation reduces the efficiency of the executives of the institute by requiring them to participate in the responsibilities for routine operating details. Paragraph 3.46 explains how the United Nations will assist INDE in solving this and related problems.
- 3.15 Procurement and contracting of construction work, services and supplies by the institute, if the amount exceeds US\$3,000, must be consistent with Article 52 of its charter, according to the following rules:
- a. Public or private invitations for bids shall be made;
  - b. A representative of the Office of the Controller of Accounts must participate when bids are opened;
  - c. Awards must be made by the Board of Directors, upon receiving the opinion of a qualifying commission composed of a representative of INDE, a representative of the Ministry of Communications, one of the the Ministry of Finance and Public Credit and another of the Office of the Controller of Accounts.
- 3.16 Lastly, any transfers of goods by INDE exceeding US\$3,000 must be approved by government agreement through the Ministry of Communications and Public Works. 1/

3. Technical assistance from the United Nations

- 3.17 Aware of the institutional shortcomings faced by INDE, its authorities decided to apply for technical assistance in the areas of organization, accounting, administration, financial management and project follow-up, rate calculations and invitation for bids.

With the approval of its Board of Directors and the intervention of the Department of Economic Planning of the Government, negotiations

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1/ See paragraph 2.36 explaining the scope of Legislative Decree 59-71 of 1971, declaring the Chixoy project a national priority of urgent nature.



have been initiated with the United Nations for a technical assistance program that the United Nations would offer to INDE in an amount equivalent to US\$300,000. It is expected that this technical assistance will be contracted by the end of 1975.

3.18 Briefly, the scope of the program would require the following personnel:

- a. An expert in project administration and implementation, for 24 months.
- b. An expert in project planning, for 24 months.
- c. An expert in accounting and financial planning, for 24 months.
- d. An expert in institutional reorganization, for 12 months.
- e. Short-term advisors for 16 man/months for problems relating to rate calculation, bidding, and the INDE-EEGSA situation.

3.19 Additionally, an attempt would be made to interest the United Nations in financing consulting services in research and geology for an approximate cost of US\$200,000.

B. Rate System of INDE

3.20 According to the law that created it (Article 56 "A") INDE is required to study, formulate, review and supervise the application of rates. The instrument governing the relations of INDE with its users is the General Regulations on Electric Services, approved by its Board of Directors in July 1967.

Concerning rates specifically, the existing regulations correspond to what was approved on June 1, 1974, which called for decreasing consumption blocks and classifying users into six major categories: residential service, electric service in general, high-voltage service, restrictive service (high-voltage), public lighting service and private outdoor lighting service.

There is no legal provision defining the rate base which could be used to measure the rate of return obtained in electric service operation. In this regard, a standard annex would be included in the loan contract describing the methodology used to compute the rate of return of INDE, in which the rate base is defined. 1/

3.21 The world petroleum crisis that began in 1973 caused major repercussions in the INDE. The cost of fuel in 1974 was more than three times

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1/ This methodology will be accepted based on communications from the Manager of INDE to the Bank and to the World Bank.



that in 1973. This caused the institute to decide to shift the higher fuel cost to the consumers, even though only to its block buyers (Guatemalan Electricity Company and eight municipal electric utilities), which account for 91% of total INDE sales. Billings on retail sales (9% of total sales of INDE), with the exception of two large consumers, do not carry any fuel adjustment clause. The billings on retail sales by EEGSA include the higher fuel costs charged to it by INDE.

3.22 The developments in the average prices of energy since 1971 are shown in the next table:

I N D E

Average Selling Prices

	1971 1/			1972 1/			1973 1/			1974 1/		
	SCI	EXT	T	SCI	EXT	T	SCI	EXT	T	SCI	EXT	T
Mean Price (Cent/KWH)												
Block sales	1.72	2.73	1.78	1.69	2.62	1.74	1.66	2.65	1.70	2.83 <sup>2/</sup>	2.73	2.82
Retail sales	-	4.55	4.45	-	4.75	4.75	-	4.85	4.85	-	4.5	4.5
Charges Sales (Thous. US\$) (GWH)												
Block sales	324.4	20.1	344.5	378.7	22.5	401.2	458.2	23.4	481.6	489.4	34.1	523.5
Retail sales	-	25.7	25.7	-	30.9	30.9	-	37.8	37.8	-	46.6	46.6
Block sales	5,579	549	6,128	6,407	590	6,997	7,588	619	8,207	13,827	931	14,758
Retail sales	-	1,169	1,169	-	1,469	1,469	-	1,834	1,834	-	2,098	2,098

1/ SCI: Central Interconnected System (Sales to EEGSA)

EXT: External Systems (Western + Eastern + Atlantic)

T: Total + (SCI + EXT)

2/ A new rate began to be applied to EEGSA in January 1974

Source: Memorias de Labores 1971-1974.



- 3.23 As may be seen, the rate levels applied to retail sales have remained unchanged in the last two years. The average prices for energy block sales, as a result of the new rate billed to EEGSA starting in January 1974, increased about 66%. 1/ The average prices shown include the higher costs billed for fuel.

The comparison of the weighted average rate is now made up in the following manner:

Basic rate	US\$10.30 mills/KWH
Fuel adjustment	US\$19.43 mills/KWH
Total	<u>US\$29.73 mills/KWH</u>

C. Historical Financial Analysis of INDE

- 3.24 According to Article 37 of the law that created it, INDE is exempt from all types of taxes, charges, levies and customs duties in existence or to be established.
- 3.25 In Article 31, the law that created INDE stipulates that its policy will be to capitalize its net income to use it to finance and carry out national electrification plans.
- 3.26 Article 32 states that INDE shall not transfer any part of its income to the general revenue of the government.

Statements of condition

- 3.27 The historical financial analysis of INDE was performed based on the financial statements audited by independent public accountants for the fiscal years ending December 31, 1971 to December 31, 1974. 2/
- 3.28 The comparative condensed statement of condition for the abovementioned years is shown ahead. 3/

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1/ Paragraph 3.63 gives an explanation on the effect on INDE's financial projections of the potential rise in rates being negotiated at this time with EEGSA for application in 1976.

2/ In their opinions for the years 1971 to 1974, the external auditors indicated some weaknesses in the internal control mechanism of INDE, as explained in paragraph 3.37.

3/ The analytical comparative statement of condition is shown in Appendix M.



(In US\$)

<u>Type of consumer</u>	<u>Total billing</u>	<u>30 days</u>	<u>60 days</u>	<u>90 days</u>	<u>120 days</u>	<u>150 days</u>	<u>180 days</u>	<u>More than 180 days</u>
Residential	134,435	109,947	24,739	2,749	-	-	-	-
Commercial	60,933	48,747	10,968	1,218	-	-	-	-
Industrial	61,242	55,118	5,510	612	-	-	-	-
Government	167,250	8,363	8,363	11,997	11,997	11,995	17,995	90,542
Municipal	103,124	20,624	20,624	18,562	15,468	12,374	10,312	5,157
Public lighting	308,020	30,802	30,802	30,802	30,802	30,802	30,802	123,208
Block sales:								
EEGSA	2,534,970	1,148,226	118,758	118,758	118,758	118,758	118,758	792,955
Others	451,166	162,757	67,674	-	-	-	-	217,737
<b>Totals</b>	<b>3,821,140</b>	<b>1,584,584</b>	<b>287,438</b>	<b>184,698</b>	<b>177,025</b>	<b>179,929</b>	<b>177,867</b>	<b>1,229,599</b>
<b>% above the balance at 12/31/74</b>	<b>100</b>	<b>40</b>	<b>8</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>32</b>



As shown by the preceding table, at December 31, 1974 60% of consumer of accounts receivable were past due, with 32% more than 6 months overdue. It should be pointed out that 18% of these accounts were in the public sector, 64% owed by the Empresa Eléctrica de Guatemala, S.A. <sup>1/</sup> and the remaining 18% by Empresas Municipales (Municipal Enterprises) of the interior of Guatemala, which purchased block energy from INDE.

- 3.33 If the trends in the composition of the consumer accounts receivable category are analyzed, the following situation comes forth:

<u>Analysis by age of consumer accounts receivable</u>				
	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>
	%	%	%	%
Current billing	59	60	57	40
Accounts past due for	41	40	43	60
60 days	9	9	9	8
90 days	3	3	4	5
120 days	3	3	3	5
150 days	3	3	3	5
180 days	2	3	3	5
More than 180 days	21	19	21	32
	100	100	100	100

The above table shows a deterioration in the situation of accounts receivable, reflected in the increasing percentage of accounts past due compared with total accounts receivable.

- 3.34 The problem is not one of non-collection of accounts but of delay in collection, in particular in the category of more than 180 days past due, which is composed of the balances due from government agencies and, only for 1974, from EEGSA.
- 3.35 The percentage of amounts outstanding and past due from government in relation to the total accounts receivable developed as follows:

	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>
Percentage of total accounts past due corresponding to the government	80%	81%	94%	36%

<sup>1/</sup> Amounts past due were paid by EEGSA, which at May 31, 1975 only owed on current billing.



3.36 Although there is evidence of a decline in the percentage of accounts past due from the government and official entities in relation to total accounts past due, it is felt that the collection problem should be corrected over a prudent period of time. It is therefore recommended that INDE and the government should submit a plan to the Bank, within one year of the date of signing the loan contract, to reduce the collection period on accounts due from the government sector to 90 days or less. 1/

3.37 At December 31, 1974 the allowance for doubtful accounts represented 5% of consumer accounts receivable. It is felt that this reserve adequately covers any eventual non-collectibles that might arise.

Deferred assets

3.38 This is represented by the interest payable on acquisition of the Michatoya generating system over 10 years starting from fiscal year 1971.

Net worth

3.39 The initial net worth of INDE was 15 million quetzals (Q15,000,000) that the Government of Guatemala contributed to INDE from the proceeds of a bond issue called for by the Legislative Branch pursuant to Decree 1268 (the law that created INDE) of December 1958.

The INDE net worth is also made up of budget appropriations by the government to supplement its own resources which the institute earmarks for its investment programs.

Finally, contributions in support of works construction requested by agencies of the government and other consumers, as well as the capitalization of annual profits, make up the total net worth of the enterprise.

In the last four years the INDE net worth has increased by 46%, totaling approximately US\$57 million at December 31, 1974.

Long-term liabilities 2/

3.40 These liabilities, representing 31% of the total net worth and liabilities of INDE at December 31, 1974, are made up of funded debt and consumer deposits and totaled at that date US\$27.5 million, representing an increase of 50% over 1971. At that date, funded debt 3/ amounted

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1/ See Recommendations.

2/ Long-term balances from banks and other creditors were confirmed directly by the independent accountants who examined the financial statements of INDE.

3/ See Appendix N.



to US\$27.4 million and was composed of: 1) internal debt for US\$2.5 million arising from "Treasury Bonds-Electric Energy Program 1973-75" for a total amount to be issued of US\$20 million, placed at par value and with a term of 15 years at interest rates ranging from 2.5% to 10% per annum according to the market where the bonds were negotiated; 2) debt to international agencies amounted to about US\$24.9 million.

As stated in the INDE charter (Article 53) the obligations legally contracted by the institute will have the unconditional and unlimited guarantee of the government.

- 3.41 With regard to the financing obtained from international agencies, INDE has agreed with the World Bank (Loans 487-GU and 545-GU) that the institute shall not incur any debt with repayment period of more than one year unless its net income (net operating income prior to financing charges plus depreciation) for the fiscal year immediately preceding the year when such debt is incurred, or for a subsequent period of 12 months terminating prior to such date, whichever is greater, is at least 1.4 times the maximum requirement of debt servicing on the entire debt (including debt to be incurred) in any subsequent year. As revealed by the historical financial analysis, within the period analyzed INDE has fulfilled the stipulations of that clause.
- 3.42 Consumer deposits, to guarantee payment by the consumers, represented US\$109,000 at December 31, 1974.

#### Current liabilities

- 3.43 Current liabilities are composed primarily of supplier accounts payable (the most important category with 3% of the total net worth and liabilities of INDE and 56% of current liabilities at December 31, 1974), the current portion of long-term debt, and miscellaneous accumulated liabilities.

#### Deferred liabilities

- 3.44 These represent municipality contributions to finance the introduction of energy into their areas, which are subject to final settlement upon completion of the work. The balance of these liabilities represented US\$229,000 approximately at December 31, 1974.

#### Financial ratios

- 3.45 The following financial ratios for the period being examined were prepared based on the statements of condition of INDE:



	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>
Current ratio	1.9	2.1	1.7	1.9
Collection ratio (days)	76	83	76	90
Debt ratio	0.5	0.5	0.5	0.5
Return on fixed investment %	5	5	5	6
Return on equity %	3	3	3	4

The current ratio has been at very satisfactory levels throughout the four years examined. The collection period has shown difficulties since it largely exceeds the amount of time allowed for paying bills of 30 days starting from the time they are presented. In order to overcome this problem it is recommended that a clause be included in the loan document setting up a condition for reducing the delay in payment of consumer accounts.

- 3.46 The debt ratio shows a comfortable financial situation and its values indicate limited use of long-term credit to finance expansions in fixed assets during the time examined.

The rate of return on investments in fixed assets has remained at uniform levels, even though relatively low, particularly in view of the fact that they were calculated based on historical values without any updating to reflect the monetary devaluation effects. Therefore, a recommendation is included that INDE reevaluate those assets in order to obtain a more realistic rate of return. 1/

- 3.47 In this regard it should be pointed out that INDE has not fulfilled the clauses under loans issued by the World Bank pertaining to achievement of a rate of return on its net average fixed assets of at least 9%, which will be required by the Bank in this operation. 2/

Lastly, the rate of return on equity has been small, even though recovery began in fiscal year 1974 when the rate of return was 4%.

#### Statements of results

- 3.48 The statements of results for INDE are given ahead:

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1/ See Recommendations.

2/ See proposed resolution and paragraph 3.63.

# I N D E

## Statements of Results 1971 to 1974 (In US\$)

	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>
<u>Operating data</u>				
Number of consumers	30,916	37,471	44,264	52,144
Block sales of energy GWH	346	401	482	523
Retail sales of energy GWH	24	31	37	47
Total, energy sales GWH	370	432	519	570
Average rate for block sales KWH	1.78	1.74	1.70	2.82
Average rate for retail sales KWH	4.54	4.75	4.70	4.54
<u>Operating income</u>				
Energy sales		<u>Amount</u>	<u>Amount</u>	<u>Amount</u>
- In block	6,127,724	84	6,997,157	83
- Retail	1,180,618	16	1,482,811	17
Total energy sales	7,308,342	100	8,479,968	100
<u>Operating costs</u>				
Fuel	909,849	13	1,476,409	17
Maintenance and other operating costs	1,623,998	22	1,182,705	15
Depreciation	1,588,715	22	1,737,736	20
Insurance	92,378	1	97,463	1
Administrative costs	665,104	9	1,598,500	19
Total operating costs	4,880,044	67	6,092,813	72
Net operating income	2,428,298	33	2,387,155	28
Other income	115,078		243,160	
Other costs	231,695		294,499	
Other costs - net	(116,617)	(2)	(51,339)	1
Income before financing charges	2,311,681	31	2,335,816	27
Financing charges	990,049	14	1,036,750	12
Net income	1,321,632	17	1,299,066	15



The various categories in the Statement of Results table are analyzed ahead:

Operating income

- 3.49 These are represented by energy sales that went from 370 MWH in 1971 to 570 GWH in 1974, equivalent to an increase of 54%. These sales were basically made to other distributors (block sales): Empresa Eléctrica de Guatemala, S.A. (EEGSA) and Empresas Eléctricas Municipales.

Sales to EEGSA represent the greatest volume of MWH, representing in 1974 93% of block sales and 86% of total sales by INDE. Retail sales, in turn, accounted for only 14% of total INDE sales in MWH.

The developments in average sales prices are indicated in paragraph 3.20 on "Rate Schedule".

Operating costs

- 3.50 Operating costs increased by 174% in terms of money during the period analyzed (energy sales increased by 131%) and in unit values per kilowatt/hour sold they increased by 77% (the average price of the energy sold increased 50%).

As can be seen from the comparative statement of results, the item that experienced greatest growth was fuel, which underwent a 734% change, that is 7.5 times more than the level in 1971. The item representing maintenance and other operating costs showed a reduction in 1972 in relation to 1971, which can be explained by the connection of the isolated Western System (Oriente) to the National Interconnected System, resulting in the shut-down of several small generating plants with subsequent reduction in operating and maintenance costs.

- 3.51 General administrative costs increased during the four years examined at a cumulative annual rate of approximately 45%. The other costs - net category is made up by combining miscellaneous non-operating costs and income of slight individual significance. Lastly, financing charges represented approximately 10% of operating income over the period analyzed.
- 3.52 The next table is presented by way of summary to illustrate the trends, during the period under examination, of the most significant operating figures:

Base 1971 = 100

	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>
Energy sales (GWH)	100	117	140	154
Operating income	100	116	137	231
Operating costs	100	125	151	274
Net operating income	100	98	108	146
Interest	100	105	113	124
Net income	100	98	96	154

From the preceding table it can be seen that, by increasing more rapidly than sales, the operating costs caused a slower growth in net operating income as the result of the delay in reflecting higher operating costs in rates. As indicated when the rate schedule of INDE was discussed, the average block sales rate was adjusted only once in the last four years (January 1974), whereas no change occurred during that period in the rate on retail sales. This explains the decline that has occurred in net income in 1972 and 1973 in comparison to 1971 and the recovery that took place in fiscal year 1974.

#### Source and application of INDE funds

- 3.53 The comparative statement of source and application of funds for the period covering 1971 to 1974 is given ahead.

The proportion of funds internally generated, which represented an average of 37% for the period examined, declined continuously from 45% in 1971 to 31% in 1974, despite the increase in absolute money terms.

The external resources, in turn, grew gradually in absolute values and also as a share, ranging from 55% in 1971 to 69% in 1974, an average of 63% for the four years. There was a rising share of government subsidies to support the construction program of INDE and there was a relative decline in loans for financing the program.

Funds were applied basically to the construction program of the institute and for debt servicing which consumed an average of 74% and 17%, respectively, of total resources during the period examined.

- 3.54 The number of times that internal generation of funds covered debt servicing was as follows:

	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>
Debt servicing coverage, in times	2.4	2.2	2.3	1.8



(In thousands of US\$)

	1971		1972		1973		1974	
	Amount	%	Amount	%	Amount	%	Amount	%
<u>Assets</u>								
Fixed assets, net	54,611	91	61,249	91	69,052	91	79,515	89
Current assets	4,436	7	5,485	8	6,763	9	9,268	10
Deferred assets	775	2	629	1	480	-	357	1
Total assets	59,822	100	67,363	100	76,295	100	89,140	100
<u>Liabilities and net worth</u>								
Net worth	38,868	65	42,732	63	48,354	63	56,725	64
Long-term liabilities	18,459	31	21,973	33	24,002	31	27,526	31
Current liabilities	2,322	4	2,571	1	3,915	6	4,660	5
Deferred liabilities	173	-	137	-	23	-	229	-
Total liabilities and net worth	59,822	100	67,363	100	76,294	100	89,140	100

3.29 As shown in the above statement, total assets of INDE have grown by approximately 50% over the period analyzed. The structure of its assets and liabilities, however, has remained practically unaltered. The most significant item in the assets category is net fixed assets which, at December 31, 1974, accounted for 89% of total assets, whereas net worth constituted the most significant item in the liabilities and net worth category, accounting for 64% of the total on that date.

Fixed assets

3.30 Goods and services correspond basically to generating plants, transmission lines, transformer stations and distribution systems. During the period examined, the net book value of the electric plant increased from US\$54.6 million to US\$79.5 million, equivalent to a 46% increase approximately.

Current assets

- 3.31 Current assets increased their relative share slightly at the close of fiscal year 1974, when they accounted for 10% of total assets in comparison with 7% for the 1971 fiscal year. At December 31, 1974 the main item in current assets was accounts receivable, amounting to US\$3.9 million or 43% of current assets, compared to US\$1.1 or 35% at December 31, 1970.
- 3.32 As indicated in the financial ratios, 1/ the average collection period of 90 days in 1974 shows that collections have been slow. The age of accounts past due from various types of consumers at the close of operations in fiscal year 1974 was the following:

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1/ See paragraph 3.45.



The historical financial analysis of INDE reveals that the lack of timely rate adjustments to meet higher operating costs and generate funds for further projects has caused INDE to depend increasingly on budget appropriations from the Central Government to meet its investment programs.

# I N D E

## Statement of Source and Application of Funds

1971 to 1974

(In US\$)

Source of funds	1971		1972		1973		1974		Total	
	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%
<b>Internal sources</b>										
Income before financing charges	2,311,681	27	2,335,816	22	2,392,740	20	3,267,928	19	10,308,165	21
Depreciation	1,588,715	18	1,737,736	16	1,970,124	17	2,236,617	12	7,533,192	16
Internal generation of funds	3,900,396	45	4,073,552	38	4,362,864	37	5,504,545	31	17,841,357	37
<b>External sources</b>										
Government subsidies and contributions from government agencies	1,737,254	20	3,190,258	29	5,468,874	47	8,270,303	47	18,686,689	38
Customer contributions for construction	50,804	1	152,252	1	-	-	10,050	-	216,106	-
Loans	2,793,838	32	3,449,710	32	2,063,895	17	3,493,019	20	11,800,462	25
Consumer deposits	4,103	-	14,824	-	14,536	-	30,594	-	64,057	-
Increase (decrease) in deferred liabilities	105,449	2	(35,409)	-	(114,264)	(1)	206,352	2	162,128	-
Total external sources	4,711,448	55	6,774,635	62	7,433,041	63	12,010,318	69	30,929,442	63
Total sources of funds	8,611,844	100	10,848,187	100	11,795,905	100	17,514,863	100	48,770,799	100
<b>Application of funds</b>										
Net additions to electric plant	5,366,000	62	8,377,000	77	9,772,000	83	12,760,000	73	36,275,000	74
Increase (decrease) in deferred charges	700,351	8	(145,975)	(1)	149,449	1	(122,766)	(1)	581,059	1
Debt servicing	625,000	8	780,000	7	820,000	8	1,889,500	11	4,114,500	8
- Amortization	990,049	11	1,036,750	10	1,120,260	9	1,228,092	7	4,375,151	9
- Interest	-	-	-	-	-	-	-	-	-	-
Total debt servicing	1,615,049	19	1,816,750	17	1,940,260	17	3,117,592	18	8,489,651	17
Total application of funds	7,681,400	89	10,047,775	93	11,861,709	101	15,754,826	90	45,345,710	92
Surplus (deficit) in funds	930,444	11	800,412	7	(65,804)	(1)	1,760,037	10	3,425,089	8
Accrued surplus (deficit)	930,444		1,730,856		1,665,052		3,425,089			



D. Financial Projections on INDE

a. Projection of statement of results

- 3.55 The summary projection of INDE results for the next ten years is given ahead:

# I N D E

## Condensed Projection of Results (with the project)

1975-1984

(In thousands of US\$)

	Actual 1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Total 1975-1984
Operating income	16,895	19,503	21,945	24,672	28,024	32,199	36,652	42,395	47,335	52,753	58,753	364,191
Operating costs	13,355	17,107	25,303	26,457	30,829	37,462	38,354	37,032	34,098	33,325	34,500	314,487
Net operating income	3,550	2,396	(3,358)	(1,785)	(2,805)	(5,263)	(1,702)	5,323	13,237	19,428	24,253	49,724
Other income - net	(272)	(278)	(278)	(287)	400	400	400	400	400	400	400	3,643
Income before financing charges	3,268	2,674	(3,080)	(1,498)	(2,405)	(4,863)	(1,302)	5,723	13,637	19,828	24,653	53,367
Financing charges	1,228	1,480	2,918	3,813	6,440	7,828	9,033	14,008	12,681	20,952	18,976	98,129
Net income (loss)	2,040	1,194	(5,998)	(5,311)	(8,845)	(12,691)	(10,335)	(8,285)	956	(1,124)	5,677	(44,766)



3.56 The preceding table shows that the following would happen if the assumptions that were used materialize:

- (a) Net operating income would be negative during the period of project execution because of the increasing effect of operating costs that have not been offset by rate adjustments. Starting with 1981 the net result would begin to be positive on a sustained basis largely owing to the decreasing effect of fuel as an item of operating costs due to entry into operation of Pueblo Viejo.
- (b) The progressive trend of financing costs, however, precludes the achievement of net income in the projections, except in the last year, although it can be stated that in 1984 the negative trend of results would change towards more satisfactory levels.
- (c) Consequently, the rate of return on equity is negative up to 1983. In 1984, after the entry into operation of Pueblo Viejo, positive rates would begin to be recorded.

b. Projections of Source and Application of Funds 1/

3.57 The ten-year projections for the statement of source and application of funds are shown ahead and indicate that if the assumptions used in preparing the projections are realized, the major source of funds would be external, an average of 80% of the total resources to be obtained. Chief among these external sources would be loans, to average 44% in the next decade, and contributions to INDE capitalization that the Government of Guatemala is expected to make in the equivalent of US\$278 million 2/ so no deficit of funds will occur. Taken together, these would represent the Pueblo Viejo project (equivalent of US\$130 million) and budget appropriations (equivalent to US\$148 million), all of which accounts for 42% of the anticipated sources (US\$763 million).

3.58 The internal generation of funds during the construction periods shows a performance that is not very uniform because of the negative operating results. Starting with 1980, however, internally generated funds would begin to reach gradually higher levels. This source represents, as an average for the period covered by the projections, approximately 20% of total sources of funds.

As will be seen in the project of sources and use of funds, there is neither a deficit nor a surplus of funds. In this regard, the mission

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1/ The bases used are shown in Appendix Q.

2/ This contribution from the government would decline by the equivalent of US\$124 million if 35% rate increases are approved starting with 1976.

was informed of the Guatemalan government's decision to provide financial support to INDE through budgetary appropriations for capital transfers or through loans. Accordingly, final deficits during the next decade are considered to represent future contributions by the Guatemalan government to INDE.

- 3.59 The number of times that internal generation of funds will cover debt servicing throughout the period 1975-1984 would be as follows:

<u>Years</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
Times debt servicing is covered	1.74	0.11	0.45	0.27	0.11	0.41	0.52	0.99	0.82	1.02

As can be noted, the only years when internally generated funds cover or exceed debt servicing are 1975 and 1984, since in no other years is debt servicing fully covered by internally generated funds.



I.N.D.E.

Projected Source and Application of Funds (with the Project)  
1975-1984  
(In thousands of US\$)

	Actual 1974	1975	1976	1977	1978	1979	Projected 1980	1981	1982	1983	1984	1975-1984
<b>Sources of funds</b>												
Internal sources before financing charges	3,268	2,674	-3,030	-1,498	-2,405	-4,863	-1,302	5,723	13,637	19,828	24,653	53,367
Depreciation	2,237	2,850	3,709	4,986	5,450	6,250	8,017	9,528	18,390	18,536	18,691	96,407
Internal cash generation	5,505	5,524	629	3,488	3,045	1,387	6,715	15,251	32,027	38,364	43,344	148,774
<b>External sources</b>												
Loans												
Existing and under negotiation	3,493	21,124	22,171	23,436	39,516	52,998	51,491	14,890	3,052	0	0	228,678
Proposed IDB loan	0	0	1,889	19,439	15,164	17,093	23,816	22,124	5,475	0	0	105,000
Total loans	3,493	21,124	24,060	42,875	54,680	70,091	75,307	37,014	8,527	0	0	333,678
Government contribution	0	0	12,237	18,384	11,854	19,070	30,914	30,182	7,471	0	0	130,112
Province Chixoy	0	0	16,138	18,028	20,426	24,492	19,891	19,150	5,274	12,504	2,969	148,008
Capital contributions	8,270	9,136	28,375	36,412	32,280	43,562	50,805	49,332	12,745	12,504	2,969	278,120
Total government contributions	8,270	9,136	28,375	36,412	32,280	43,562	50,805	49,332	12,745	12,504	2,969	278,120
Construction AID contributions	216	100	100	100	100	100	100	100	100	100	100	1,000
Consumer deposits	31	50	55	61	67	74	81	89	98	108	119	802
Total external sources	12,010	30,410	52,590	79,448	87,127	113,827	126,293	86,535	21,470	12,712	3,188	631,600
Total sources of funds	17,515	35,934	53,219	82,936	90,172	115,214	133,008	101,786	53,497	51,076	46,532	783,374
<b>Application of funds execution of projects</b>												
IDB proposed	0	0	19,526	44,830	43,099	65,603	89,336	62,482	15,998	0	0	340,874
Other projects 1/	12,637	32,663	28,099	30,002	36,107	36,308	27,102	9,150	3,870	3,930	3,994	211,223
Total projects	12,637	32,663	47,627	74,832	79,206	101,911	116,438	71,632	19,868	3,930	3,994	552,099
<b>Debt service</b>												
Interest	0	0	309	545	1,135	1,500	1,500	1,125	625	4,175	3,855	14,769
IDB project	1,228	1,480	2,609	3,268	5,305	6,328	7,533	12,883	12,056	16,777	15,121	83,360
Other debts	1,228	1,480	2,918	3,813	6,440	7,828	9,033	14,008	12,681	20,952	18,976	98,129
Total interest	2,456	2,960	5,527	9,081	11,745	14,156	16,566	26,891	24,737	37,727	34,097	181,498
<b>Amortization</b>												
IDB project	0	0	0	0	0	0	0	0	0	2,432	2,432	4,864
Other debts	1,890	1,690	2,960	3,933	4,943	5,063	7,412	15,123	19,541	23,518	20,930	105,113
Total amortization	1,890	1,690	2,960	3,933	4,943	5,063	7,412	15,123	19,541	25,950	23,362	109,977
Total debt service	3,118	3,170	5,878	7,746	11,383	12,891	16,445	29,131	32,222	46,902	42,338	208,106
Increase (decrease) in working capital	0	101	-284	358	-417	412	125	1,023	1,407	244	200	3,169
Total application of funds	15,755	35,934	53,219	82,936	90,172	115,214	133,008	101,786	53,497	51,076	46,532	763,374
Surplus (deficit) in funds	1,760	0	0	0	0	0	0	0	0	0	0	0

1/ Includes the gas plants, the Escuintla steam plant, the Aguacapa hydro plant, the Moyuta geothermal plant and plant expansions to existing systems.

c. Proforma general balance sheet 1/

- 3.60 The general balance sheets projected for INDE are shown in Appendix S. The basic financial ratios obtained from those statements are the following:

<u>Year</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
Current ratio	1.55	1.28	1.16	1.10	1.15	0.78	0.68	0.54	0.56	0.59
Debt ratio	0.68	0.74	0.86	1.06	1.21	1.22	1.10	1.01	0.90	0.79

As can be seen, although the current ratio declines gradually, it stays within acceptable levels throughout the period covered by the projections.

- 3.61 The debt ratio, however, shows unsatisfactory levels since INDE could not generate sufficient funds internally to meet its debt servicing, as pointed out in the comments on the projected source and application of funds statements. Regarding the proposed project it is recommended that as of the date of the prospective loan contract INDE shall commit itself to incur no long-term debt that would: (i) result in an increase in the debt/equity ratio greater than 1.4:1; and (ii) result in an internal generation of funds annually less than one times the amount required to meet debt servicing in the subsequent year. 2/

- 3.62 The rate of return on investment in fixed assets would develop as follows:

<u>Years</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
Rate of return on investment in fixed assets (%) 3/	4	n.a.	n.a.	n.a.	n.a.	n.a.	3	3	4	5

In view of the heavy operating losses expected between 1976 and 1980, the rate of return on net investment in fixed assets would be negative in those years. Only by 1981 would the earning power begin to recover gradually, even though at very low levels, particularly taking into account that it is obtained on values not adjusted for monetary devaluation. Such an adjustment would cause an additional decline in the ratios obtained based on the rate revenues considered in the projections of results.

1/ The bases used are shown in Appendix O.

2/ See Recommendations.

3/ Net investment in fixed assets equals average net fixed assets (plant in service) + average current assets.



- 3.63 At the time when this report was being prepared, new contract clauses were being negotiated with EEGSA to govern the future sale of block energy by INDE, since the present contract is due to expire in December 1975. These negotiations are going on at the level of the Board of Directors of both institutions. They are particularly important in view of the negative operating results that the institute would experience if it does not raise its rates substantially. According to the most recent information obtained from INDE, the technical studies being used as a basis for negotiating with EEGSA include an increase of 50% in rates starting with 1976 which, based on the volume of sales to that entity, would represent an increase of 43% over total operating income of INDE. Based on the most conservative projections it was assumed that the rate negotiated with EEGSA would be around 40%, with an overall impact on INDE's operating income of 35%. This would have a favorable effect on net investment in fixed assets, which would make it possible to reach more satisfactory levels of return without revaluating goods and service, as shown in the next table.

# I N D E

## Rate of Return on Investment in Fixed Assets with a 35% Increase in Rates

	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
Sales in GWH	737	828	940	1,082	1,233	1,427	1,596	1,780	1,984
Differential rate	7,856	8,826	10,020	11,534	13,144	15,212	17,013	18,975	21,149
Net operating result before rate adjustment	(3,080)	(1,498)	(2,405)	(4,863)	(1,302)	5,723	13,637	19,828	24,653
Net operating result after rate adjustment	4,776	7,328	7,615	6,671	11,842	20,935	30,650	38,803	45,802
Average net investment in fixed assets	72,711	94,831	114,513	125,690	162,763	206,426	285,123	542,576	528,937

Rate of return %	7	8	7	5	7	10	8	7	9
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- 3.64 Furthermore, if this rate increase is obtained the internal generation of funds of the institute would be sufficient to cover the debt service once (one time). This condition is stated in the recommendations.
- 3.65 It is furthermore recommended that a clause should be put into the eventual loan contract to the effect that INDE obtain a rate of return of at least 9% on its revaluated investment in fixed assets 1/ starting with the entry in operation in 1982 of the Pueblo Viejo plant.

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1/ The rate of return of 9% is the one called for by the World Bank relative to INDE in the two loans that bank granted it.

#### IV. JUSTIFICATION

##### A. Technical Feasibility

- 4.01 The technical conception of the design was the result of careful studies conducted during the prefeasibility and feasibility stages. In both stages an attempt was made to optimize the various parts of the project, combining economic criteria and appropriate safety factors for these structures.
- 4.02 The geological aspects of the project were analyzed by the consultants, who for this purpose contracted the advisory services of an expert of international renown, Professor R. Barbier of the University of Grenoble, France. The survey of the surface geology was supplemented by drilling and geophysical testing. Upon completion of the feasibility study and for the purpose of obtaining more details on the subsurface geology of the area along the proposed bearing of the tunnel, INDE contracted the same consultant, the LAMI consortium, to conduct the supplementary investigations. This work included deep drilling, geophysical site investigation based on measurements of electrical resistivity, seismic refraction, shooting, and a recently applied technique: audiofrequency magnetic fields measurement (similar to the magnetotelluric method) which allows subsurface fault zones to be located.

In view of the importance of geology in determining the feasibility of the tunnel construction and for estimating the costs of the tunnel, the Bank contracted an expert to review all of the studies carried out in this matter and to give an opinion. The opinion was favorable as regards the feasibility of the works, even though the time and cost were greater than estimated by the LAMI consultants.

- 4.03 The hydrologic surveys were based on records of streamflow and rainfall at various points in the Chixoy River basin. In view of the fact that those studies did not go back a sufficient number of years, it was necessary to prepare a model to program a monthly hypothetical generation at streamflows, with which average discharge values could be obtained at the dam site and consequently the mean plant output. In order to determine the millennial flood a model was used that related the rainfall to the runoff, establishing the flood volume to be discharged by the spillway, having taken into account the reservoir retaining effect.

In view of the silting carrying condition of the Chixoy River, the consultants paid particular attention to the problem of sedimentation, and for that purpose they contracted the services of the international expert Professor W. M. Borland. Based on his recommendations, an estimate was made of the volume of sediments over the useful life of the project and the portion of the reservoir needed for storing them, without reducing regulated plant output.



- 4.04 The budget of the project is based on designs with a high degree of advance at the bidding document level and a detailed analysis of unit prices, which was subsequently refined by the technical units of the Bank with the help of the expert contracted for reviewing the geologic aspects. The construction schedule and the time allowed for completion are considered realistic, with adequate margins of safety for works of this kind.
- 4.05 The above considerations make it possible to conclude that the project has a sound and well-founded design, that its costs and execution period are reasonable, and that it is, therefore, technically feasible.

B. Financial Feasibility

Feasibility of the Local Contribution

- 4.06 The local contribution, equivalent to US\$130 million, will be made by the government in the following manner:
- i. The equivalent of US\$60 million from the resources of its investment budget (Energy Sector Program) for the period 1975-1985, which is part of the National Development Plan for the same period.
  - ii. The balance, equivalent to US\$70 million, would come from the long-term option of the oil facility arrangement between Guatemala and the Venezuelan Investment Fund.

Since the local contribution to the project will be financed by resources of the Government, the Government will have to allocate the needed funds for the project on a priority basis.

- 4.07 To illustrate the significance of the contributions required by INDE from the Central Government, the following table was prepared:

Central Government of Guatemala

(Equivalent in thousands of US\$)

<u>Year</u>	<u>Current Receipts</u>	<u>Investment C o s t s</u>
1972	185,137	81,445
1973	213,187	82,418
1974	281,008	107,914

If to the maximum amount of local contribution (net of allowance for cost escalation) of US\$8.9 million in 1981 are added the other contributions of the government required in that year of US\$19.2 million,

a maximum contribution commitment of US\$28.1 million is obtained. This amount represents 10% of the current revenue and 26% of the total investment of the Government of Guatemala in 1974.

If the rate increase mentioned in paragraph 3.91 materializes (which signifies a reduction of US\$124 million equivalent in the Government's contribution to INDE during 1975-1984), the contribution of the Government in the year 1981 (which is the year that will require the greatest financial effort) would be reduced by approximately US\$15 million and, consequently, the total contribution required in 1981 would be US\$13.1 million. This amount would constitute 5% of current revenue and 12% of the investment made by the government in 1974.

- 4.08 If considering that 54% approximately of the local counterpart funds to the project will have to come from the Venezuelan Investment Fund, which will constitute additional resources for the Government of Guatemala, the final impact of the budget appropriations for INDE would be reduced to 3% of current revenue and 8% of investment outlays of the Central Government for 1974.
- 4.09 The analysis conducted based on the projections permits the following conclusions:
- a. It is felt that INDE will have sufficient resources to meet local counterpart contributions under the financing plan of the proposed project, taking into account that these funds will come from the government and that the government contribution is in reasonable proportion to its revenue and investment outlays for 1974.
  - b. The existing level of rates, which is the one used in preparing the financial projections, is not sufficient to enable INDE to meet its operating and financing expenses and provide for debt servicing during project execution. Based on the revenue required, it was calculated that the rate that would have to be charged to cover those costs and the debt servicing turned out to be approximately 35% higher than the current rate.
  - c. If a rate adjustment of 35% is made, the requirements for government contributions to INDE would be reduced by an equal amount, which has been estimated at approximately US\$124 million for 1976-1984. 1/

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1/ That is, that the contributions from the Government to INDE during 1975-1984 would be equivalent to US\$154.1 million, including the contribution for the Chixoy project.



Also, because a debt-equity ratio acceptable to the Bank would approach 1.5:1.0, whereas the debt ratios that INDE would record in the next 10 years would not reach that level, part of the contributions to be made by the Government of Guatemala could be in the form of loans. The loans would have to be on concessionary terms and have a grace period not less than the time needed for execution of the project.

- d. The projected source and application of funds statement shows that INDE would be able to go ahead with the works that are part of its expansion programs and meet its commitments in this regard, provided that the assumptions used turn out to be true, which include the obtention of the financing now being negotiated and contributions from the Government to the capitalization of INDE, in the form of capital contributions and loans.

4.10 As the result of the evaluation made, the following special conditions, in addition to the standard clauses, are included in the normative elements: 1/

- a. The borrower and the guarantor shall take such measures as are appropriate and acceptable to the Bank so that the rates for supply of energy of the INDE systems (i) produce revenue that is at least sufficient to cover all of the operating costs of the electric system, including those relating to administration, operation and maintenance, billing and collecting, and depreciation; (ii) provide a reasonable rate of return on investment in fixed assets of the electric system; and (iii) if the cash flow from the above is not sufficient to cover timely servicing of all the financial obligations of INDE that the rates should generate the additional revenue needed for this purpose.
- b. INDE shall proceed with a rate adjustment representing a 35% increase in its current average rate, to be applied starting with 1976.
- c. If the rate adjustments that might occur during the project execution period do not generate sufficient funds to cover all of the other investments and expenditures of INDE, the borrower shall agree to take the necessary measures to this end.
- d. Before 30 days have elapsed in each fiscal year and during execution of the project, the borrower shall submit evidence that the necessary resources have been set aside in the respective investment budgets to meet the local contribution to

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1/ See proposed resolution and Recommendations.

the project during the fiscal year in question, as a contribution to the capitalization of INDE in the form of direct capital contributions or reimbursable loans.

- e. Within 120 days following the close of each fiscal year for INDE, starting with the one ending December 31, 1975 and during the life of the loan, INDE shall submit its financial statements and those of the project and supplementary information relative to these statements, audited by a firm of independent public accountants.
- f. Starting with the date of the contract, INDE shall not, without prior authorization from the Bank, incur any long-term debts resulting in an increase in the debt-equity ratio greater than 1.5:1. Furthermore, the internal generation of funds shall represent at least one times the total debt servicing in each of the three following years, including that of the debt to be contracted.
- g. Within the first year of the date the contract is signed, but before December 31, 1976, INDE shall have completed the revaluation of its assets to reflect the effects of the monetary devaluation.
- h. Within one year of the signing of the loan contract, INDE and the Government of Guatemala shall submit to the Bank, for its approval, a plan aimed at reducing, in no more than three years from its implementation to 90 days or less, the collection period for energy use accounts owed by the Government sector.
- i. Strengthening of the internal auditing unit shall be included by INDE within the terms of reference for the technical cooperation being negotiated with the United Nations. These terms of reference must be satisfactory to the Bank. As regards internal auditing, the terms of reference shall cover the following aspects:
  - (a) Hiring of staff qualified in modern auditing methods, where possible having a professional degree in public accounting.
  - (b) Preparation of an internal auditing manual which, without limiting individual initiative, lists for the various operating areas of the institute the minimum auditing procedures to be used, and to serve as a guide for training new auditors.



(c) More intensive utilization of the personnel in specific auditing tasks:

1. Limiting the emphasis placed on pre-audit of income and expenditure vouchers.
2. Proper training for the staff in internal auditing methods, encouraging their participation in courses and seminars.

C. Economic Evaluation

- 4.11 The most comprehensive analysis of feasible economic alternatives, using the latest techniques available, was done in order to determine the economic feasibility of the Pueblo Viejo hydroelectric project. The economic evaluation was based on the comparison of a large number of equipment sequences rather than of separate projects, so as to find the alternative having the least present value, among those that would satisfy the predicted demand with enough reliability, stated in terms of likelihood of system loss (load loss). For these equipment programs only such hydroelectric projects as have been proven to be technically feasible and are supported by studies such as will enable their costs and schedules of execution to be carefully defined were taken. Furthermore, these generating plants show economically competitive costs of production in comparison with equivalent alternatives. The discount rate used is representative of the opportunity cost of capital, which in the case of Guatemala, is assumed to be at least 12%. Using the current price of petroleum for the thermal alternatives in the revised construction costs of the Pueblo Viejo project there is no doubt as to the superiority of the sequence initiated with Pueblo Viejo, as compared with a purely thermal sequence. Results show for the moment that it is quite likely that if the demand projections are met, expansion and demand in 1982/1993 may be supplied without it being necessary to add a thermal plant. From this analysis it follows that, in the optimum sequence, the best project available for initiating operations in 1982 is the Pueblo Viejo project and that the sequence includes also at least two other hydroelectric projects to be built before 1993.
- 4.12 In any event, the projects expected to be finished in 1976/81 were taken as presented, in view of the decisions made to cover requirements in this period and the urgent need for additional generation capacity. For the requirements in 1982 and subsequent years, none of the more economically-feasible alternatives includes thermal plants because the INDE system will already have a considerable portion of its installed capacity in thermal plants and each of the hydroelectric sequences available will produce energy at a cost substantially below that of the thermal plants.

The greatest benefits should actually be expected from the virtual elimination of the need to import fuel in the first few years of operation of Pueblo Viejo, because with its generating capacity most of the thermal plants could be shut down and utilized on a stand-by basis.

- 4.13 The combination of hydroelectric plants and thermal plants in electric systems normally follows a cycle through which the demand is first of all covered by small thermal units and then a hydroelectric plant is installed with sufficient capacity to cover the incremental demand. This would leave the least efficient thermal plants on stand-by. They could be used further on temporarily to meet some future increase in demand.

In these cases the most appropriate method of analysis is to compare several alternative expansion programs which presuppose a multiple facilities mix both in hydroelectric plants and in thermal plants, gas plants, etc. The task is to identify, with the help of computer programs, the optimum least-cost sequence.

#### Computer Programs Used

- 4.14 The evaluation was made by the technicians of the Bank, with their own computer, using the program called Wien Automatic System Planning Package (WASP II). This program was initially developed by the Tennessee Valley Authority (TVA), and was subsequently improved and recently applied in more than a dozen developing countries for planning the development of their energy sectors. <sup>1/</sup>

The program is divided into the following modules:

- i. Description of demand: There is a data bank with the characteristics of the load curve, correction factors, hydrological conditions, etc.
- ii. Description of the existing system: Everything is recorded here regarding the plants in operation and the plants actually scheduled for construction (capacity, generation, plant factor, etc.).
- iii. Description of the variable system: This lists the same characteristics as above, but for those plants that are eligible for inclusion in the expansion program, grouped by type and capacity.

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<sup>1/</sup> The results are published in Market Survey for Nuclear Power in Developing Countries, General Report (Vienna, 1973), conducted by the International Atomic Energy Agency. The countries examined include two members of the IDB (Argentina and Mexico).



- iv. Generator of expansion configuration: Based on certain data defined in advance (reserve margin, type of plant, system loss, etc.) this module is used to prepare the possible combinations for system expansion.
- v. Probability simulation: This represents dispatching of the possible combinations of plants, distributing available capacity in the most efficient manner and, taking several technical characteristics into account, calculates the probable (load) system loss.
- vi. Optimization: The dynamic programming code performs the economic evaluation of the sequences established in the preceding step, taking operating and capital costs into account, refining at the same time the reliability criteria for load maintenance.

#### Results Obtained

- 4.15 Only the hydroelectric projects were considered in the optimization, with studies at such a level as to permit establishment of their cost and execution period parameters. There are currently five projects in this category: the four involving the development of the Chixoy river (Pueblo Viejo, Tapezcos, Jocotales and Palzajel) and Atitlán, which, along with the various types of supplementary thermal equipment, are combined in the various expansion alternatives.

The sensitivity analysis, at 10% and 14% discount rates, shows that the feasibility of Pueblo Viejo is not affected, nor is the date of its setting in operation, thereby confirming its position as a priority project in the optimal sequence.

- 4.16 The optimum sequence that is obtained is the one that begins with Pueblo Viejo, followed by Atitlán and Tapezcos, in that order. Jocotales and Palzajel do not enter during the planning period, which extends to 1993. Below is a list of the results obtained in the major alternatives studied:

	Cost in present value	Relative difference to the optimum 1/ suggestion (Millions US\$)
Pueblo Viejo as the first project	432,4	-
Atitlán as the first project	476,6	+ 44,2
Pueblo Viejo as the first project (excluding Atitlán)	479,0	+ 46,6
Atitlán as the first project (excluding Pueblo Viejo)	478,9	+ 46,5

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1/ The updated value discounted at 12%.

The analysis performed by the Bank, which is summarized in the above table, shows that based on a study of the five hydroelectric projects with adequate information on demand, costs, etc., the equipment sequence should start with Pueblo Viejo, so that the Pueblo Viejo plant can enter service in 1982. Indeed, the difference in present value of US\$44.2 million in comparison to the alternative following it is very significant and provides economic justification for the choice made.

#### Master Plan

- 4.17 This long-term program financed by the Government of the Federal Republic of Germany is aimed at establishing an inventory of the water resources of Guatemala for hydroelectric use, for the purpose of optimizing the development of these resources in a plan extending to the year 2000.

The program consists of three stages. The first stage, which assumed the obtention of the inventory of potential projects, has already been completed. The second stage is in the process of being completed and consists in refining the parameters on the project selected (cost, capacity, production, etc.) in order to then pass on to the last stage, which consists in establishing some new demand projections (based on updated rates, etc.) and determining the optimum development sequence. Thus, a group of projects was defined in the first stage among which only the project of Chulac on the Cahabon river, which has characteristics similar to those of Pueblo Viejo, was included. Nevertheless, the Chulac project is located in an area with serious geologic problems, which made it impossible to properly determine its costs and therefore the final feasibility studies are needed to permit comparison with Pueblo Viejo.

Thus, the results of the first stage reveal that, in its class, Pueblo Viejo has first place and priority.

Lastly, it should be pointed out that a master plan is a dynamic programming instrument and must therefore be continuously revised and updated in keeping with the changes occurring in the parameters considered, such as demand, fuel prices, rates, and construction costs.

#### Socioeconomic Impact

##### Effect on the Balance of Payments

- 4.18 Any sequence of hydroelectric projects would exert favorable effects, reducing the importing of fuel (Bunker C). The Pueblo Viejo project, in view of its special characteristics, offers special advantages in this regard.



The effect on fuel substitution (not only compared to other hydro-electric alternatives) indicates that starting with 1982, when the project will enter service, there will be a gross annual savings of about 2.5 million barrels or US\$30 million at May 1975 prices will be realized. This substitution effect will be considerable, taking into account that Guatemala is not now producing petroleum.

In order to determine net saving, the lower expenditure should be discounted by debt service payments stemming from foreign loans acquired for the construction of Pueblo Viejo, but taking into account that if this project is not constructed the country would have to be equipped with thermal plants. Since in order to construct these plants external loans would likewise be needed, the fact is that the net savings on Guatemala's balance of payments will be the difference between fuel expense and debt servicing on the alternative thermal plants, less service on the debt acquired for the Pueblo Viejo Project, this balance being for the year in which this plant will be producing at full capacity, yielding a net saving in foreign exchange of about US\$28 million.

#### Social Effects

- 4.19 Besides the impact produced by execution of the project in regard to generating a large stream of revenue in the project area and the effects on the national economy, the project would provide employment to an average of 1,500 technicians and workers during the execution period and about 100 on a permanent basis.
- 4.20 The project will have an important effect through the training, experience and specialization that the personnel employed will receive during the construction. Guatemala will benefit from this training of human resources in future projects of the same nature, some of which could be built within the Chixoy River basin.
- 4.21 In addition to this direct employment effect, the project will exert significant spillover effects on employment, although these indirect labor force employment effects are difficult to quantify. This creation of indirect employment arises as the result of:
  - The size of the construction materials item that will be purchased domestically, increasing production and employment in industry and commercial activity.
  - The additional demand for food and provisions on the part of the labor force and the families, creating a market and encouraging commercial activity.

- 4.22 In adopting the most economic electric power generation system to meet the energy needs of the area, as is the case for the Pueblo Viejo project, the operating and administration costs would be at the minimum feasible level, with a favorable effect on the necessary rates. Any other alternative would involve higher costs and consequently higher rates, which would exert an unfavorable social impact on residential users and the public sector and constitute an additional economic burden on industrial and commercial users.
- 4.23 The structure of the existing basic rates-schedules constitutes a subsidy from industrial and commercial consumers in favor of residential consumers, as well as a subsidy from the relatively high income consumers of Guatemala City in benefit of the lower income families living in other areas of the country. Only 15% of all of the families living outside of the area of the central system had electric service in 1973, with very low consumption levels. Consequently, the absolute and relative growth in the population served and the energy consumed will probably be much greater outside of the central area. Thus, the increase in energy arising from the Pueblo Viejo project would provide more than proportional benefits to the low income families living in the areas outside of the central zone.
- 4.24 It can be estimated that the total number of persons in the families benefited through electric energy would grow from a total of 550,000 in 1973 to more than 1,000,000 in 1982, when the project is put into service. The energy consumed by the residential beneficiaries of those small systems would more than double during that period.

Appendix I shows the relatively low consumption of energy and family income of the central system, which is summarized in the table below.



Residential Electric Consumption in Guatemala, Year 1973

	<u>Guatemala</u> <u>C i t y</u>	<u>Other</u> <u>areas,</u> <u>central</u> <u>system</u>	<u>Other</u> <u>systems</u>	<u>Total</u> <u>for the</u> <u>Republic</u>
Total consumption (GWH)	151.7	26.1	12.9	190.7
Number of consumers (in thousands)	82.0	35.5	38.1	155.7
Average consumption (KWH)	1,850	736	337	1,225
Urban population served (1,000)	786.0	318.2	549.3	1,653.5
% of total population	74%		15%	32%
Consumers per household	9.4		14.4	10.6
Average family income, 1970 Urban areas (in quetzales)	4,946		2,870	3,976

Source: Appendix I

Development of the Region

- 4.25 The Government has asked the Bank for nonreimbursable technical cooperation. It would be used to identify development possibilities for the basin of the Chixoy river, using in part the hydraulic facilities that would be located in the mid-section of that river and consolidating the development of the entire service area.

To this end, an overall regional development program would be prepared, which would be set up based on utilization of the water resources of the basin and would include the study of the entire development potential of the area in the fields of agriculture, industry, services and human resources, as well as the determination of the necessary infrastructure.

- 4.26 To achieve the objectives of the project, the services would be contracted of a consulting firm or entities specializing in general regional development, which would provide the services of experts in regional development planning, water resources, geology, economic evaluation of projects, physical planning and services, social planning, hydrology, ecology, design of hydraulic facilities and others considered necessary to carry out the program.

- 4.27 This technical cooperation program is a supplement to the project since it will provide the necessary guidance and training for overall utilization of the resources available throughout the river basin and specifically in the project area, facilitating the development of the natural resources of the basin and increasing the socioeconomic benefits of the proposed investment in a largely rural area.
- 4.28 On the other hand, the results of the investigation of the valley of the Chixoy River showed that the Pueblo Viejo project would have a particularly limited negative social impact. The area in question is sparsely populated and the social change arising from the necessary resettling will be small. Nevertheless, the population affected of about 200 families, or 1,200 persons, will have to be prepared, consulted and assisted in the problems arising from construction of the project.
- 4.29 The adversely-affected population is almost exclusively indigenous with a small degree of flexibility and cultural mobility. Therefore the change might be very difficult for them and a concept of resettling that is limited to simple payment of compensation and to prevent physical, economic and social inconveniences would be inadequate today. On the contrary, it is necessary to place the necessary resettling within the national socioeconomic development policy, promoting an improvement in the living conditions of the population in the service area of the project. The solution would be sought in practice in a development program of the basin of the Chixoy River, where improved use of land and land conservation will be combined with the development of the new lands, as set forth in the technical cooperation that would be financed by the Bank.

#### Environmental Aspects

- 4.30 The evaluation of the environmental effect in the project area was made by experts during the course of the prefeasibility studies concerning the hydroelectric development of the Chixoy Medio River. Those environmental investigations included human ecology, public health, flora, fauna, hydrology and archeology.
- 4.31 The results of the investigation show that the project will have a very small negative effect on the environment of the project area. The scattered population, the lack of significant farming land, the low level of pollution and the absence of water-borne diseases, mean that this is an environmentally advantageous project. There are only three areas that require greater consideration: human ecology, public health and archeology. But these considerations are not as serious as those found usually in comparable projects. By taking appropriate measures it will be possible to reduce the negative impact to a minimum and to improve the overall environment still further.



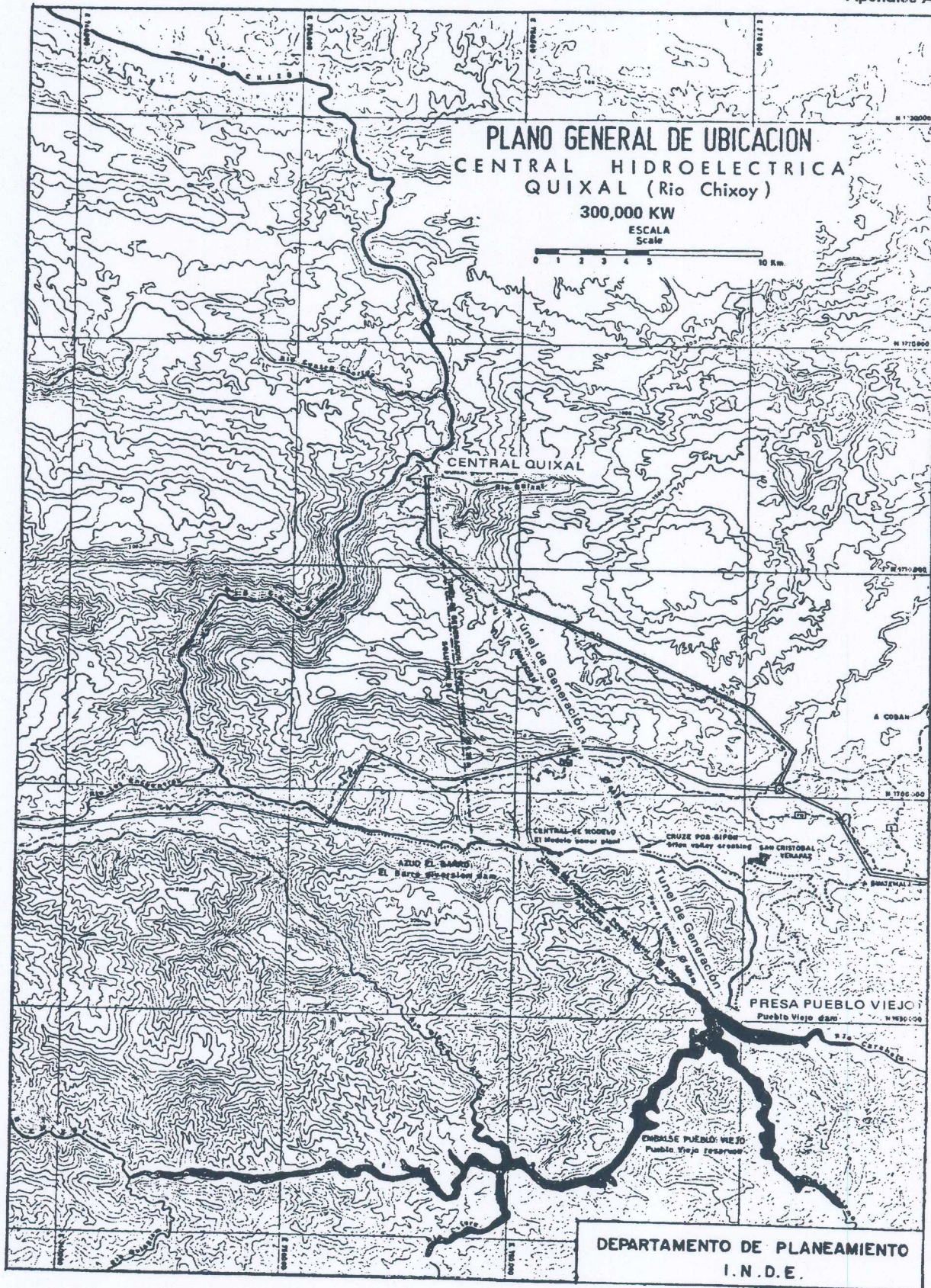
- 4.32 As to the archeology, two sites of apparently lesser importance, called "Plan de Tierra Negra" and "Cauinal" would be flooded by the Pueblo Viejo dam. Contacts have been initiated between INDE and the Dirección del Instituto de Antropología e Historia de Guatemala - IDAEH (Management of the Institute of Anthropology and History of Guatemala) in March and August 1975 to carry out an archeological salvage program that includes an evaluation of the archeological value and the condition of the structures and eventually salvaging of the structures.
- 4.33 The health conditions in the project area are currently satisfactory. There are risks, however, that the conditions could eventually change as the result of the creation of the dam and the influx of a large number of workers and families from outside of the region. A three-party agreement is currently being set up between INDE, the Dirección General de Servicios de Salud (General Bureau of Health Services) and the Instituto Guatemalteco de Seguridad Social - IGSS (Guatemalan Social Security Institute) in order to be able to cover the public health area for the existing population and the workers on the project.
- 4.34 As a general conclusion to the complete evaluation of the hydroelectric project it can be stated that the sum of the economic, social and environmental costs is very small in comparison to the economic effect and social and environmental benefits that the project could exert through a careful overall development policy.
- 4.35 Conclusions to the Justification
- a. The demand on the generating system of INDE requires that a plant be put into operation in 1982, since if this is not done there would be energy and power deficits in the following years.
  - b. The optimization analysis of sequences made permits concluding that the alternative with the least economic cost is the one that includes the Pueblo Viejo plant, entering into service in 1982.
  - c. The indirect benefits improve the situation of the balance of payments by reducing imports of oil, generate employment of manpower in construction and have an effect on the national economy as the result of the investments in local currency.
  - d. In their social and ecological aspects, the costs have a small effect, since the project is located in an area that is practically unpopulated, has slight agriculture and livestock potential, and has a small environmental impact. It will be necessary, nevertheless, to plan a suitable policy for resettlement in order to avoid an unfavorable reaction from the small population affected by the project.

- e. The existing rate structure permits an adequate distribution of benefits among all of the consumption sectors and would facilitate the expansion of service to rural areas with low-income consumers.

Recommendations

- 4.36 The technical cooperation agreement now being processed for the coordinated development of the Chixoy River basin shall include the preparation of a plan for resettling the families affected by the Pueblo Viejo reservoir.







GUATEMALA

PROYECTO PUEBLO VIEJO  
COSTO DE CONSTRUCCION  
(en miles de US\$)

Categorías	Costo Total		
	ME	MN	Total
<b>1. INGENIERIA Y ADMINISTRACION</b>			
1.1 Ingeniería y supervisión	10 282	2 421	12 703
- Firma consultores	9 682	2 421	12 103
- Junta especial consultores	600	-	600
1.2 Administración y gastos generales	-	5 187	5 187
Total Categoría 1	10 282	7 608	17 890
<b>2. COSTO DIRECTO DE CONSTRUCCION</b>			
2.1 Lote A (Obras auxiliares y expropiaciones)	4 920	10 330	15 250
- Carreteras de acceso	4 920	8 380	13 300
- Campamentos	-	1 100	1 100
- Expropiaciones	-	850	850
2.2 Lote B (Aducción, casa máquinas, etc.)	49 895	31 114	81 009
- Túnel incluyendo bocatoma	42 365	26 030	68 395
- Sifón agua blanca	2 685	448	3 133
- Almenara	1 753	1 009	2 762
- Casa de máquinas 1/	2 498	3 172	5 670
- Obras civiles tubería de presión	594	455	1 049
2.3 Lote C (Desvío, presa, vertedero)	17 706	10 132	27 838
- Túneles de desvío	1 850	1 303	3 153
- Presa embalse	7 589	4 369	11 958
- Vvertedero	8 267	4 460	12 727
2.4 Lote D1 (Equipo mecánico)	12 971	1 414	14 385
- Turbinas	10 575	1 175	11 750
- Válvulas y stop logs	2 126	209	2 335
- Puente grúa	270	30	300
2.5 Lote D2 (Equipo eléctrico)	12 420	1 380	13 800
- Generadores	7 290	810	8 100
- Transformadores	2 430	270	2 700
- Equipo auxiliar (control, protección, etc.)	2 700	300	3 000
2.6 Lote D3 (Equipo hidromecánico)	7 145	820	7 965
- Tubería de presión	5 940	660	6 600
- Compuertas, válvulas y rejas	1 165	155	1 320
- Piezas fijas compuertas vertedero	40	5	45
2.7 Lote E (Sistema transmisión)	10 209	1 605	11 814
- Subestación Quixal	1 922	122	2 044
- Línea Quixal-Guatemala Norte	5 389	1 263	6 652
- Subestación Guatemala Norte	2 898	220	3 118
Total Categoría 2	115 266	56 795	172 061
COSTO DE CONSTRUCCION	125 548	64 403	189 951

1/ Incluye subestación y canal de fuga.



GUATEMALA

PROYECTO PUEBLO VIEJO  
MONTO Y PROGRAMA DE LICITACIONES  
(en miles de US\$)

Lote	Items	Apert.	Cierre	Adjud.	Monto Estimado <u>1/</u>			Financiamiento				
					ME	MN	Total	BID	BIRF	BCIE	Prov.	Local
A	Obras complementarias	Jul.75	Set.75	Nov.75	4 920	10 330	15 250	-	-	4 920	-	10 330
B	Aducción, casa máquinas	Ene.76	May.76	Oct.76	49 895	31 114	81 009	49 895	-	-	-	31 114
C	Desvío, presa, vertedero	Ene.77	May.77	Oct.77	17 706	10 132	27 838	-	17 706	-	-	10 132
D1	Equipo mecánico	May.76	Set.76	Mar.77	12 971	1 414	14 385	-	-	-	11 674	1 297
D2	Equipo eléctrico	"	"	"	12 420	1 380	13 800	-	-	-	11 178	1 242
D3	Equipo hidromecánico	Ene.77	May.77	Oct.77	7 145	820	7 965	-	7 145	-	-	820
E	Sistema transmisión	Ago.78	Dic.78	Abr.79	10 209	1 605	11 814	-	10 209	-	-	1 605
	Total				115 266	56 795	172 061	49 895	35 060	4 920	22 852	59 334

1/ No incluye gastos sin asignación específica.

## Items

## Carreteras, campamentos

Bocatoma,  
Túnel de carga  
Almenara,  
Tubería de presión  
Casa de máquinas  
Canal de fuga

Túneles desvío  
Presa  
Vertedero

Turbinas, válvulas, etc.

Generadores, transformadores, etc.

Tubería, válvulas, compuertas

Línea 220 KV  
Subestaciones

1/ Incluye fabricación y transporte.

	1976	1977	1978	1979	1980	1981	1982
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APENDICE E

GUATEMALA  
PROYECTO FUEA-1120  
CROMOSOMA DE INVERSIONES  
(En miles de US\$)

	1976			1977			1978			1979			1980			1981			1982		
	ME	MN	Total	ME	MN	Total	ME	MN	Total	ME	MN	Total	ME	MN	Total	ME	MN	Total	ME	MN	Total
<b>A. INVERSIONES</b>																					
1 INGENIERIA Y ADMINIST.	10 282	7 608	17 890	1 542	1 141	2 683	1 542	1 141	2 683	1 542	1 141	2 683	1 542	1 141	2 683	2 057	1 921	3 978	515	381	896
2 COSTO DIRECTO CONSTR.																					
Lote A	4 920	10 330	15 250	4 920	9 480	14 400	4 920	9 480	14 400	4 920	9 480	14 400	4 920	9 480	14 400	4 920	9 480	14 400	4 920	9 480	14 400
Lote B	49 895	31 114	81 009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lote C	17 706	10 132	27 838	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lote D	12 971	1 414	14 385	1 946	1 510	3 456	1 946	1 510	3 456	1 946	1 510	3 456	1 946	1 510	3 456	1 946	1 510	3 456	1 946	1 510	3 456
Lote D2	12 420	1 380	13 800	1 863	-	1 863	1 863	-	1 863	1 863	-	1 863	1 863	-	1 863	1 863	-	1 863	1 863	-	1 863
Lote D3	7 145	820	7 965	1 072	-	1 072	1 072	-	1 072	1 072	-	1 072	1 072	-	1 072	1 072	-	1 072	1 072	-	1 072
Lote E	10 209	1 605	11 814	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Categoría 2	115 266	56 795	172 061	4 920	9 480	14 400	4 920	9 480	14 400	4 920	9 480	14 400	4 920	9 480	14 400	4 920	9 480	14 400	4 920	9 480	14 400
3 GASTOS FINANCIEROS																					
Intereses préstamo BID	11 724	-	11 724	42	-	42	42	-	42	42	-	42	42	-	42	42	-	42	42	-	42
Intereses otros prest.	20 967	-	20 967	164	-	164	164	-	164	164	-	164	164	-	164	164	-	164	164	-	164
Comisiones préstamos BID	2 408	-	2 408	309	-	309	309	-	309	309	-	309	309	-	309	309	-	309	309	-	309
Comisiones otros prest.	1 362	-	1 362	86	-	86	86	-	86	86	-	86	86	-	86	86	-	86	86	-	86
Inspección y vigilancia	900	-	900	140	-	140	140	-	140	140	-	140	140	-	140	140	-	140	140	-	140
Total Categoría 3	37 361	-	37 361	735	-	735	735	-	735	735	-	735	735	-	735	735	-	735	735	-	735
4 GASTOS SIN ASIGNACION																					
Inversiones generales	14 463	7 621	22 084	3 059	1 692	4 751	3 059	1 692	4 751	3 059	1 692	4 751	3 059	1 692	4 751	3 059	1 692	4 751	3 059	1 692	4 751
Provision ejecución	63 044	28 434	91 478	4 284	2 190	6 474	4 284	2 190	6 474	4 284	2 190	6 474	4 284	2 190	6 474	4 284	2 190	6 474	4 284	2 190	6 474
Total Categoría 4	77 507	36 055	113 562	7 343	3 882	11 225	7 343	3 882	11 225	7 343	3 882	11 225	7 343	3 882	11 225	7 343	3 882	11 225	7 343	3 882	11 225
INVERSION TOTAL	240 416	100 458	340 874	7 842	11 684	19 526	7 842	11 684	19 526	7 842	11 684	19 526	7 842	11 684	19 526	11 865	4 133	15 998	11 865	4 133	15 998
<b>B. RECURSOS FINANCIEROS</b>																					
Aporte BID	105 000	-	105 000	1 889	-	1 889	1 889	-	1 889	1 889	-	1 889	1 889	-	1 889	1 889	-	1 889	1 889	-	1 889
Aporte BIRF	65 000	-	65 000	5 400	-	5 400	5 400	-	5 400	5 400	-	5 400	5 400	-	5 400	5 400	-	5 400	5 400	-	5 400
Aporte BIRF	35 362	-	35 362	5 400	-	5 400	5 400	-	5 400	5 400	-	5 400	5 400	-	5 400	5 400	-	5 400	5 400	-	5 400
Aporte proveedores	29 654	100 458	130 112	553	11 684	12 237	553	11 684	12 237	553	11 684	12 237	553	11 684	12 237	553	11 684	12 237	553	11 684	12 237
Aporte local	240 416	100 458	340 874	7 842	11 684	19 526	7 842	11 684	19 526	7 842	11 684	19 526	7 842	11 684	19 526	11 865	4 133	15 998	11 865	4 133	15 998
RECURSOS TOTALES																					

APENDICE E