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APPRAISAL OF SIXTH POWER PROJECT-EL SALVADOR
COMISION EJECUTIVA HIDROELECTRICA DEL RIO LEMPA (CEL)

April 11, 1973

Regional Projects Department
Latin America and the Caribbean Regional Office

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UNITS AND MEASURES

kW	=	kilowatt
MW	=	megawatt = 1,000 kW
kWh	=	kilowatt hour
GWh	=	gigawatt hour = 1,000,000 kWh
kV	=	kilovolt
kVA	=	kilo volt-ampere
MVA	=	mega volt-ampere
m	=	meter = 3.28 ft
km	=	kilometer = 0.621 mi
km ²	=	square kilometer = 0.386 sq mi
m ³	=	cubic meter = 35.3 cu ft
ha	=	hectare = 10,000 square meters = 2.471 acres
kcal	=	thousand calories
kg	=	kilogram = 2.2046 pounds
at.a.	=	atmospheres absolute = 14.69 lb/sq in
MCM	=	thousand circular mills

CURRENCY EQUIVALENTS

Currency Unit	=	Colon (¢)
¢	=	100 centavos
¢1	=	US\$0.40
¢1,000,000	=	US\$400,000
1 centavo	=	0.4 US cents
US\$1	=	¢2.50
1 US cent	=	2.5 centavos
1 US mill	=	0.25 centavos

FISCAL YEAR

CEL's fiscal year ends December 31

ACRONYMS AND ABBREVIATIONS

CEL	-	Comision Ejecutiva Hidroelectrica del Rio Lempa
IDB	-	Inter-American Development Bank
UNDP	-	United Nations Development Programme
ELC	-	Electroconsult
IGSE	-	Inspeccion General de Servicios Electricos
CAESS	-	Compania de Alumbrado Electrico de San Salvador
CLESA	-	Compania de Luz Electrica de Santa Ana
COSAESA	-	Compania Oriental Salvadorena de Alumbrado Electrico, S. A.
CACM	-	Central American Common Market
ANDA	-	Administracion Nacional de Acueductos y Alcantarillados

APPRAISAL OF SIXTH POWER PROJECT - EL SALVADOR

COMISION EJECUTIVA HIDROELECTRICA DEL RIO LEMPA (CEL)

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This report was prepared by Messrs. John E. Graves, R.E. Salazar, and K. Ringskog.

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APPRAISAL OF SIXTH POWER PROJECT - EL SALVADOR

COMISION EJECUTIVA HIDROELECTRICA DEL RIO LEMPA (CEL)

SUMMARY AND CONCLUSIONS

i. This report covers the appraisal of the Sixth Power Project of the Comision Ejecutiva Hidroelectrica del Rio Lempa (CEL) of El Salvador which has requested assistance from the Bank and the Inter-American Development Bank (IDB) in financing the Project, the estimated total cost of which is US\$97.7 million.

ii. Since 1949 the Bank/IDA has provided major financial assistance to El Salvador's power development through four loans and one credit, totaling US\$30.3 million, for five CEL power projects. The first four projects have been completed successfully; the fifth is under construction, with satisfactory progress, and is expected to be completed by early 1973. CEL's performance under previous lending operations has been satisfactory.

iii. ~~CEL is a government-owned corporation responsible for the development of all means of generating electricity in the country and for distribution of electricity to rural zones not served by private companies.~~ CEL's installed capacity of 199 MW, comprising hydro, oil-fired steam and gas-turbine generation, represents about 90 percent of the country's total capacity available for public power supply. CEL's management is capable, but its recently-formed planning staff needs strengthening.

iv. El Salvador has only two indigenous energy sources of any magnitude: the Rio Lempa and geothermal fields. Optimal power development will involve a balanced utilization of geothermal energy to satisfy base-load requirements and hydro energy to meet peak demand. Until now El Salvador has depended on conventional oil-fired units to complement the hydro generation from the Cinco de Noviembre plant located on the Rio Lempa and the smaller Guajoyo plant on a Lempa tributary.

v. With UNDP assistance in the 1960s, CEL has been studying El Salvador's geothermal resources since 1953. As a result of these studies, CEL has established the feasibility of building an initial installation of 30 MW at the ~~Ahuachapan geothermal field~~; the station is expected to have a final capacity of about 100 MW. ~~The Project includes this first Ahuachapan unit, which will be the first such installation in the country.~~

vi. Also included in the Project are: ~~the first two 67.5 MW units at Cerron Grande hydroelectric development; a telemetering center for communication within the CEL system; studies of future projects; and training of CEL's professional staff.~~ The Cerron Grande plant, the second on the Rio Lempa itself, would have an ultimate capacity of 270 MW. Flooding of land by the Cerron Grande dam will necessitate relocation of a large number of people; this relocation will be carried out by CEL in accordance with a plan acceptable to the Bank.

vii. The proposed IBRD loan of US\$27.3 million and the IDB loan of US\$38.1 million, totaling US\$65.4 million, would cover all the Project's foreign exchange cost of US\$59.9 million, except a US\$0.5 million IDB commitment fee, which CEL will finance. The IDB loan would also include US\$6 million equivalent of local currency financing. It would be made from IDB's Fund for Special Operations on soft terms to the Salvadoran government, which would re-lend the proceeds to CEL on the same terms during the Project's construction period and on conventional terms thereafter. The IDB loan would finance most civil works, supply of the turbo-generator units and installation of all equipment at Cerron Grande. The proposed IBRD loan would finance: the Ahuachapan geothermal station; engineering, diversion works and the supply of equipment other than turbo-generators at Cerron Grande; transmission lines related to both generating stations; studies of future projects; and training.

viii. Consulting engineers acceptable to the Bank would carry out the design and construction supervision of all physical works and studies included in the Project.

ix. Because IDB would finance most of the Cerron Grande hydro project and has or will have supervisory capability both in Washington and El Salvador, it would have primary responsibility for supervision of construction of that project. The Bank would have primary responsibility for supervising CEL's operations, would supervise procurement of all items which it finances, and would be solely responsible for supervising construction of all project elements which are not directly related to the Cerron Grande hydro plant.

x. Procurement of items financed by the Bank would follow the Bank's guidelines. To meet its estimated demands CEL would have to make commitments for engineering and key Project elements prior to loan signing, involving retroactive financing of US\$1.2 million for engineering and equipment for the geothermal unit and US\$0.6 million for engineering and diversion works for the Cerron Grande hydro plant.

xi. CEL's proposed expansion program, which includes completing to their ultimate capacity the two generating stations included in the Project, represents the least-cost solution of meeting El Salvador's electricity needs for discount rates up to 16 percent. The return on the program investment is estimated to be at least 17 percent.

xii. CEL's financial position and earnings are satisfactory and are expected to remain so, except for a temporary reduction in rate of return expected directly after commissioning of the Cerron Grande hydro station.

xiii. The Project would form a suitable basis for a loan of US\$27.3 million equivalent, including US\$4.6 million of interest during construction, with a term of 25 years including five years of grace. The loan would be made to CEL and would be guaranteed by the Republic of El Salvador.

APPRAISAL OF SIXTH POWER PROJECT - EL SALVADOR

COMISION EJECUTIVA HIDROELECTRICA DEL RIO LEMPA (CEL)

1. INTRODUCTION

1.01 This report appraises the Sixth Power Project of the Comision Ejecutiva Hidroelectrica del Rio Lempa (CEL) for which assistance from the Bank and Inter-American Development Bank (IDB) has been requested. The proposed loans would cover all but US\$0.5 million (the IDB commitment fee) of the Project's foreign exchange cost of US\$59.9 million, which represents about 60% of the Project's total cost of US\$97.7 million, including financing costs. In addition, the IDB loan would include US\$6 million equivalent of local currency financing, thereby reducing CEL's local borrowing requirements. CEL, the government-owned entity responsible for generation and bulk supply of electricity within El Salvador, would finance the Project's remaining local cost of US\$32.3 million from internally generated funds and local borrowing.

1.02 With the assistance of the United Nations Development Programme (UNDP), CEL has been studying El Salvador's geothermal resources since 1953 to determine their optimum use; it has thereby established the feasibility of building an initial installation of 30 MW at the Ahuachapan geothermal field. The Project would include this initial geothermal installation, the first in El Salvador and in Central America. It would also include a hydroelectric plant at Cerron Grande with initial capacity of two 67.5 MW units and related transmission lines.

1.03 The Bank and IDA have helped finance five power projects in El Salvador. Bank/IDA financing, which has aggregated US\$30.3 million, has assisted in the construction of almost all of CEL's generating and transmission facilities. CEL's performance under previous lending operations has been satisfactory.

1.04 The Project appraisal was carried out in close cooperation with the staff of IDB, which institution would provide most of the external financing for the Cerron Grande hydroelectric plant. The Bank financing would be applied principally to the Ahuachapan geothermal plant, certain equipment for Cerron Grande, and the transmission lines.

1.05 This report, which was written by John E. Graves, R. E. Salazar and K. Ringskog, is based on:

- a. A feasibility study of the Ahuachapan geothermal plant prepared by Electroconsult (ELC) of Italy, and a UNDP-financed study of the geothermal field and plant done by Kingston Reynolds Thom & Allerdice of New Zealand and Kennedy & Donkin of the United Kingdom in association with New Zealand government agencies (Kingston et al);

- b. a feasibility study of the Cerron Grande hydroelectric plant prepared by Harza Engineering Company International (Harza) of the United States and Atilio Garcia Prieto y Cia. (Garcia Prieto) of El Salvador; and
- c. the findings of an appraisal mission consisting of Messrs. W. F. Kupper, John E. Graves, R. E. Salazar and H. Maeda which visited El Salvador in September 1972.

2. THE POWER SECTOR

Energy Resources

2.01 El Salvador has only two indigenous energy resources of any magnitude: the Rio Lempa and geothermal fields. Since the creation of CEL in the 1940s, Salvadoran power development has been concentrated on the Lempa river system, with oil-fired steam units at Acajutla and gas turbines added to balance the power system; future development focuses on continued exploitation of the Rio Lempa and geothermal resources.

2.02 The 81 MW Cinco de Noviembre hydro plant at Guayabo, whose first units (Loan 22-ES) were commissioned in 1954, is the principal installation on the Lempa itself. Additional units (Loans 221-ES and 342-ES) were added to this plant through 1966. The 15 MW Guajoyo plant (Loan 263-ES) is located on the outlet of Lake Guija, which discharges into a tributary of the Lempa (see map for plant locations). Lake Guija serves as an additional reservoir for the Cinco de Noviembre plant; it is drawn down during the dry season. The Guajoyo plant operates only during this drawdown period, which coincides with the months of peak power demand.

2.03 On the Rio Lempa there are two potential sites downstream from the Cinco de Noviembre plant - El Tigre and La Pintada. Because its reservoir would inundate Honduran territory as well as Salvadoran, development of the large (approximately 400 MW) El Tigre site would require an agreement between the two countries and must therefore await resolution of current political difficulties with Honduras. La Pintada would be a run-of-river installation with a capacity estimated at about 80 MW; it would not be economic without upstream regulation. The proposed Cerron Grande development, located immediately upstream from Cinco de Noviembre, would provide the necessary regulation. Because of low river flows, hydro sites upstream from the proposed Cerron Grande project are uneconomic. The few potential hydro sites on other rivers are small and appear uneconomic.

2.04 Geothermal studies and explorations have indicated that the Ahuachapan field has a total energy potential of about 24,000 GWh, and that other fields also have some additional potential (see Annex 5). Development of these other geothermal fields will require additional exploration to establish reserves; CEL intends to proceed with this exploration program once it has gained operating experience with the initial installation at Ahuachapan.

2.05 Under its present program, which includes the completion of the proposed initial unit at Ahuachapan in early 1975 and the first two sets at Cerron Grande in 1976 and 1977, CEL will require additional generating capacity in 1979 and additional energy in 1981. Expansion of the proposed Cerron Grande plant would appear to be the least-cost solution to satisfy the need for additional capacity to meet peak loads. Subject to the experience to be gained from the initial geothermal installation and further studies, CEL

intends to expand the Ahuachapan plant, as outlined in Annex 5, to provide base-load energy. If geothermal expansion is not feasible, CEL will have to add oil-fired steam units in 1981 to provide energy, thus increasing its dependence on imported fuel.

Organization of the Power Sector

2.06 Prior to CEL's creation in 1945, El Salvador's electricity needs were served exclusively by private companies. CEL was created by law to study the hydro resources of the Rio Lempa; subsequent amendments to its enabling legislation gave it the responsibility of developing all means of electricity generation for public service.

2.07 With the assistance of the Bank and IDA, CEL has provided practically all generating and transmission facilities in El Salvador since 1954 and has interconnected all the distribution companies serving the country. In addition to the 12,000 retail customers it serves in nine rural zones as a result of its rural electrification program (see paragraph 3.10), CEL sells electricity to two industrial customers, various government agencies and eight private distribution companies. The largest of the distribution companies are: Compania de Alumbrado de San Salvador (CAESS), 88% owned by Canadian International Power of Montreal and 12% by Salvadoran and foreign individuals; and Compania de Luz Electrica de Santa Ana (CLESA), owned locally. Details of 1971 generation and sales of electricity by each utility are shown in Annex 1, and the attached map indicates the zone served by each.

2.08 As detailed in Annex 1 and summarized below, CEL generated about 92% of the electric energy available for public service in 1971:

	Capacity in MW	Generation	
		GWh	Percent
CEL	166.1	655.7	92.1
CAESS	11.8	19.8	2.8
Other utilities	<u>7.9</u>	<u>36.3</u>	<u>5.1</u>
	<u>185.8</u>	<u>711.8</u>	<u>100.0</u>

In addition to the above, eleven thermal plants of 500 to 2,500 kW capacity each and about 25 smaller hydro and thermal plants with total installed capacity of 19.9 MW furnished 30.9 GWh for private use during 1971. The majority of these captive plants supply sugar mills and other installations for processing agricultural products, principally cotton and coffee.

2.09 CAESS, which serves San Salvador and the central part of the country as well as a large zone in eastern El Salvador, is the largest distribution company; it distributes more than three-quarters of the electric energy sold to the public. Retail distribution in 1971 is shown below:

	<u>Retail Customers</u> (thousands)	<u>Retail Sales</u>	
		<u>GWh</u>	<u>Percent</u>
CAESS	118.0	459.8	77.5
CLESA	22.7	57.3	9.7
CEL	12.3	27.5	4.6
Other utilities	<u>24.9</u>	<u>48.6</u>	<u>8.2</u>
	<u>177.9</u>	<u>593.2</u>	<u>100.0</u>

Regulation and Tariffs

2.10 Regulatory procedures in El Salvador, which are based on the 1936 Electric Service Law and subsequent regulations and modifications, are satisfactory. The Inspeccion General de Servicios Electricos (IGSE), under the Minister of Economy, reviews the financial and technical condition of the distribution companies; and the Minister of Economy decides policy matters concerning the power sector with the advice of the executive director of CEL and the director of IGSE.

2.11 All utilities except CEL are subject to regulation by IGSE. The private companies are permitted an 8% annual return on net assets after all expenses, including taxes imposed on the companies and on dividends and remittances to shareholders. Net assets include 75% of the assessed value of assets in 1952 plus net additions at cost less depreciation since 1952. While CAESS's return had fallen considerably below 8% in the late 1960s, its rate of return improved to over 7% in 1971, and further improvement is expected. These operating results are satisfactory to CAESS, which has no tariff applications pending. CAESS's cash flow is sufficient for adequate expansion and improvement of its distribution system and for providing an annual expenditure of 600,000 (US\$240,000) annually for village electrification in its territories beginning in 1972.

2.12 Under its charter CEL is allowed, with the approval of the Minister of Economy, to establish tariffs sufficient to cover its costs and meet its obligations under agreement with creditors. In practice this has enabled CEL to earn a rate of return of at least 9% on average net assets in operation, as defined in existing Loan/Project agreements with the Bank/IDA.

2.13 The principal retail tariffs of CEL and the four largest distribution companies are detailed in Annex 2. The retail tariff structure of the various utilities are rational from a cost-of-service view point, with block energy rates and appropriate demand charges. The average retail price per kWh has decreased from 0.084 (US\$0.034) in 1961 to 0.068 (US\$0.027) in 1971. CEL's bulk rates to the distribution companies include an energy and demand charge; the resultant average charge is about 0.04 (US\$0.016) per kWh. Until 1972, the demand charge was based on the annual peak, resulting in retroactive billing, which was unsatisfactory to the distribution companies. Under new contracts, the demand charge will be applied on a monthly basis for the maximum demand in the most recent 12-month period, thereby reducing the

average price per kWh received by CEL by about 2%.

Consumption and Extension of the Electric Power Supply

2.14 During the ten-year period 1962-1971, production of electrical energy in El Salvador increased by 168%, reaching a level of 711.8 GWh in 1971. Generating capacity, which totaled about 186 MW in 1971, has kept pace with the growth in demand; supply has never been rationed. The total number of customers increased by 92% to 178,000 in the ten years through 1971. Of the total, 149,000 were residential customers, representing about 25% of the total households in El Salvador.

2.15 In 1971 El Salvador ranked third among the five Central American republics in terms of per capita generation of electricity for public service:

<u>Country</u>	<u>kWh/capita</u>
Costa Rica	577
Nicaragua	273
El Salvador	193
Honduras	127
Guatemala	124

2.16 Industrial customers form the largest market for electrical energy in the country, as indicated below. The four principal categories of consumers have used about the same proportions of energy since 1963. (Prior to 1963, consumer categories were defined differently, making comparison difficult.)

<u>Category of Consumer</u>	<u>1963 Retail Sales</u>		<u>1971 Retail Sales</u>	
	<u>GWh</u>	<u>Percent</u>	<u>GWh</u>	<u>Percent</u>
Residential	77.5	26.0	169.8	28.6
Commercial	46.5	15.6	87.2	14.7
Industrial	126.0	42.2	243.8	41.1
Government and municipal	<u>48.4</u>	<u>16.2</u>	<u>92.4</u>	<u>15.6</u>
	<u>298.4</u>	<u>100.0</u>	<u>593.2</u>	<u>100.0</u>

2.17 To continue to meet the country's demands for electricity, CEL intends to carry out the generating expansion program described in paragraph 4.01. Although CEL's rural electrification program has extended electric service to most of the country's villages, it has not brought electricity inside the majority of homes; the expanded rural electrification program (paragraph 3.10) is intended to solve this problem.

3. THE BORROWER

3.01 CEL, whose responsibilities for developing means of generating electricity are described in paragraph 2.06, is an autonomous government-owned corporation. Since 1959 it has also had responsibility for installing distribution facilities in areas not served by private companies as well as for developing all means of generating electricity in the country.

Organization and Management

3.02 CEL's seven-man Board of Directors is comprised of El Salvador's Minister of the Interior, who serves as President, the Ministers of Economy, Agriculture and Public Works, and representatives of CEL's bondholders and of the country's banks and industrial and agricultural associations. The Board, whose president has held office since 1950, establishes policy. It appoints an Executive Director who is responsible for all management functions; the present Executive Director, a capable civil engineer, had previous experience with CEL and private industry before assuming his present position in 1971. CEL's engineers and management staff are capable.

3.03 CEL currently employs about 630 operational employees, including 72 who are directly engaged in the operation of its distribution system, and about 470 in its construction forces, mostly in transmission and distribution work. Its operations are efficient and its plant, well maintained.

3.04 Until recently CEL has relied on Harza, its principal consultant, for all planning, having no internal planning organization. In 1972 CEL set up a small group to direct and review the consultant's efforts and, eventually, to decrease CEL's reliance on its consultant. To perform this function effectively, however, the planning group needs experience, additional training and more personnel.

3.05 Despite the increasing size and complexity of its system, CEL has not undertaken a long-term study of its future transmission requirements, other than those included in the Sixth Power Project. Consequently, CEL needs an overall system study to: provide for expansion of its own transmission facilities; and determine the optimum future interconnection points between its system and those of the major distribution companies. CEL has agreed to the performance of this study by consultants acceptable to the Bank.

3.06 CEL has engaged a consultant familiar with public utilities in Latin America to review its management structure and administrative procedures and to propose improvements.

Facilities

3.07 As detailed in Annex 3 CEL has about 199 MW of generating capacity located at two hydro stations, one conventional steam station, and a 33 MW gas turbine plant at Soyapango, which was financed by IDA Credit 227-ES and was commissioned in December 1972.

3.08 Extremely low rainfall in the rainy season which ended in November 1972 and the resultant drawdown of Lake Guija would have caused a power shortage by March 1973 unless CEL acquired additional capacity. Consequently, CEL has contracted to purchase a 25 MW gas turbine from Hitachi of Japan, who had a unit of this size available. This unit will be installed at Soyapango by the end of March 1973 and will be paid for by CEL's own funds. This addition is designed for use only when severe drought makes hydro facilities inoperative.

3.09 As shown on the attached map, CEL's transmission network connects all densely populated areas of the country. The network currently includes the following lengths of transmission lines.

<u>Voltage</u> (kV)	<u>Length of lines</u> (circuit km)
115	284
69	88
44	249
35	62

A 110 km 115 kV line to increase the supply of power to eastern El Salvador, also financed by IDA Credit 227-ES, is scheduled for completion in early 1973. In addition, the various distribution companies own and operate 189 km of 44 kV and 35 kV lines.

3.10 In 1961 CEL began a program of village electrification to provide electricity to rural zones not served by the private companies. Under this program CEL has constructed more than 1,000 km of 13 kV lines to most villages with a population exceeding 100 people in the rural zones it serves. Because the majority of potential rural customers still do not receive electricity, CEL will expand its program to provide more distribution works, will coordinate its promotion efforts under a centralized rural electrification office, and will study a program to assist low-income homeowners in installing basic interior wiring. The expanded program will be funded by an annual contribution of capital of about \$1.3 million (US\$520,000) from the government. This contribution represents the difference between CEL's debt service to the government on IDA Credit 227-ES and the government's debt service to IDA. In addition, CEL will contribute \$500,000 (US\$200,000) per year from its own funds to the program. In view of the social benefits to be derived therefrom, expansion of the program in this manner is reasonable.

Financial Systems and Auditors

3.11 CEL's accounting system, which is under the direction of a qualified accountant, produces prompt and complete monthly financial reports and comparisons of actual and budgeted data. The new planning group is expected to perform the financial planning, which the consultant now does.

3.12 Under Salvadoran law, independent auditors appointed by the Central Reserve Bank of El Salvador must perform annual audits of government-owned organizations such as CEL. The present auditor, appointed more than three years ago, lacks familiarity with public utility concepts and therefore is not acceptable to the Bank. Since the Central Reserve Bank appears reluctant to change auditors, CEL has engaged a second external auditor responsible to its own Board of Directors and acceptable to the Bank. While this is not an ideal solution because of the conflict which could result from two sets of auditors, the presence of an experienced auditing firm represents an improvement over the previous situation.

4. THE PROGRAM AND PROJECT

Program through 1984

4.01 CEL's development program needs through 1984 includes:

- a. completion of Soyapango Gas Turbine (Fifth Power) Project (see Appraisal Report No. PU-55a dated December 1, 1970);
- b. purchase of additional gas turbine capacity for emergency conditions (paragraph 3.08);
- c. completion of current program of drilling geothermal wells;
- d. the Sixth Power Project, which would include Ahuachapan geothermal Unit 1 and Cerron Grande hydro Units 1 and 2, described below;
- e. two additional units of 30-40 MW each at Ahuachapan in 1981 (see Annex 5);
- f. two additional units of 67.5 MW at Cerron Grande, one in 1979 and the other in 1984 (see Annex 6); and
- g. expansion of distribution facilities, including village electrification (paragraph 3.10).

Description of the Project

4.02 The Sixth Power Project will consist of:

- a. The Ahuachapan geothermal plant, comprising steam separators, silencers, a power house containing one medium-pressure (7 to 9 at. a.) 30 MW turbo-generator unit and appropriate accessory equipment, switchyard and a 60 km canal to discharge the effluent into the Pacific Ocean (see Annex 5);
- b. The Cerron Grande hydroelectric development, comprising a fill dam across the Rio Lempa, spillway, intakes and pressure tunnels, surface power house containing two 67.5 MW turbo-generator units and appropriate accessory equipment, and switchyard (see Annex 6);
- c. 115 kV transmission facilities: a single-circuit 20 km line from Cerron Grande to the Cinco de Noviembre plant; a double-circuit 34 km line from Cerron Grande to Nejapa substation; and a single-circuit 22 km line from Ahuachapan to Santa Ana substation;
- d. A telemetering center located in CEL's San Salvador headquarters;
- e. Engineering design work on the third unit of Cerron Grande and pre-feasibility or feasibility studies of projects to be agreed between CEL and the Bank; and

f. Training of CEL's professional staff.

The telemetering center will include communications equipment and equipment for supervisory control of Cerron Grande plant and switchyard, the Soyapango gas turbine plant, and certain substations; it would be expanded at a later date to provide economic dispatch, automatic load-frequency control, data logging, supervisory control and communication with the entire CEL system. The training program will supplement CEL's own staff development program and will be directed particularly towards improving the capability of CEL's recently-formed planning group (see paragraph 3.04) and geothermal engineers.

Estimated Cost and Financing

4.03 Detailed cost estimates of the Ahuachapan and Cerron Grande plants are shown in Annexes 5 and 6, respectively; the total Project cost is summarized below:

	<u>Colones (millions)</u>			<u>US\$ (millions)</u>		
	<u>Local</u>	<u>Foreign</u>	<u>Total</u>	<u>Local</u>	<u>Foreign</u>	<u>Total</u>
Ahuachapan geothermal plant and related transmission (Annex 5)	14.23	19.76	33.99	5.69	7.90	13.59
Cerron Grande hydro plant and related transmission (Annex 6)	78.57	110.30	188.87	31.43	44.12	75.55
Telemetering center	0.25	1.37	1.62	0.10	0.55	0.65
Studies of future projects	0.25	2.50	2.75	0.10	1.00	1.10
Training	-	0.50	0.50	-	0.20	0.20
Sub-total	93.30	134.43	227.73	37.32	53.77	91.09
Financing costs:						
Interest during construction on local borrowing	1.00	-	1.00	0.40	-	0.40
IBRD interest and commitment fee during construction	-	11.38	11.38	-	4.56	4.56
IDB interest during construction	0.20	1.86	2.06	0.08	0.74	0.82
IDB supervision fee	-	0.90	0.90	-	0.36	0.36
IDB commitment fee	-	1.17	1.17	-	0.47	0.47
Total	<u>94.50</u>	<u>149.74</u>	<u>244.24</u>	<u>37.80</u>	<u>59.90</u>	<u>97.70</u>

The cost estimates are based on Harza and ELC estimates with minor modifications by the IDB and Bank appraisal teams. The unit cost of the Ahuachapan plant, about US\$500/kW of installed capacity, is acceptable for a geothermal plant of this size, considering that the initial investment includes the effluent canal and other facilities that will be used in connection with subsequent units as well as the first. It is estimated that the unit cost of the plant, when completed, will be about US\$350/kW. While the unit cost of the first two units of the Cerron Grande plant is rather high (about US\$550/kW), expansion of this plant to its ultimate design capacity of 270 MW will involve a relatively small additional investment (about US\$16 million, bringing the plant's total cost to about US\$91 million) and reduce the unit cost to about US\$340/kW. As described in the respective annexes, the cost estimates for both generating plants include appropriate allowances for physical contingencies and price inflation, including possible effects of future currency revaluations, as well as a special allowance of US\$8.5 million for restricted procurement from IDB member countries of items financed with the IDB loan.

4.04 As detailed in paragraphs 6.08 and 6.10, the IDB loan will finance the foreign and part of the local cost of civil works, supply of the turbo-generator units and installation of all equipment at Cerron Grande, and financial charges related to its loan. The Bank loan would finance the foreign cost of the Ahuachapan station, engineering, diversion works and other equipment at Cerron Grande, transmission lines, the telemetering center, studies, training and interest during construction.

Engineering and Construction

4.05 ELC will perform the general engineering for the geothermal plant, and CEL's own staff will assist in this task, particularly in designing the effluent canal. CEL's staff, including geothermal engineers whose experience includes on-site training at geothermal sites in Italy, Japan and New Zealand, with the assistance of ELC will supervise construction of the Ahuachapan plant.

4.06 Harza--who has been CEL's principal consultant since the 1940s and has engineered all of CEL's hydro projects--and Garcia Prieto will carry out engineering design and construction supervision of:

- a. the Cerron Grande hydro plant;
- b. the transmission lines (including the Ahuachapan-Santa Ana line);
and
- c. the telemetering center.

The Bank has received evidence that an acceptable seismic design expert has approved the design specifications for the Cerron Grande dam and associated structures, which will be located in areas of strong seismic activity. The Bank has also received assurances from CEL that the Ahuachapan geothermal plant will be designed and built to withstand seismic effects, including dynamic seismic forces.

4.07 In accordance with its practice CEL intends to award one general contract for construction of civil works and installation of equipment at each of the two generating plants included in the Project. Equipment will be delivered C&F Salvadoran port and transported to the sites by CEL.

4.08 Two supply-and-erect contracts will be awarded for the transmission lines: one for the single-circuit lines, the other for the double-circuit.

Construction Schedules

4.09 Provisional acceptance of the Ahuachapan unit is scheduled for March 1975. Consequently, the turbo-generator contract was awarded in February 1973, and other works will begin in Spring 1973.

4.10 At Cerron Grande the diversion works were started by Columbus Latinamerica of Panama in October 1972. Construction of the main civil works is scheduled to begin in November 1973. The first unit would be placed in service by the end of 1976 to meet the year-end peak load, and the second unit would be in service by early 1977.

Procurement and Disbursement

4.11 Procurement of equipment and selection of contractors for items procured with Bank funds would follow the Bank's Guidelines for Procurement; those procured with the proposed IDB loan would comply with IDB's procedures.

4.12 In order to meet the estimated demand, CEL will have had to make commitments for engineering and key elements prior to loan signing. This would entail a small amount of retroactive financing for expenditures incurred since June 1972, the date of the Bank's pre-appraisal mission concerning the Project. The proposed retroactive financing of US\$1.8 million would be as follows:

	<u>US\$ million</u>	
Ahuachapan geothermal:		
Turbo-generator	0.8	
Other equipment	0.1	
Engineering	<u>0.3</u>	<u>1.2</u>
Cerron Grande:		
River diversion work and transmission line for power supply	0.2	
Engineering	<u>0.4</u>	<u>0.6</u>
Total		<u>1.8</u>

4.13 Disbursements from the loan account would be made for C&F cost of imported equipment and materials, for the foreign-cost component of consultant services, and for the foreign currency cost of contractors, erection work, and training. Of the total amounts of the contracts for engineering services

with ELC for the Ahuachapan geothermal plant and with Harza/Garcia Prieto for the Cerron Grande hydro development, 95% and 92%, respectively, would be considered as the foreign component. Annex 7 shows the estimated schedule of loan disbursements; the loan is expected to be fully drawn down by the end of 1977. If the Project should cost less than estimated, any savings from the loan should be canceled.

4.14 No manufacturers in El Salvador or the Central American Common Market produce equipment to be included in the Project. Therefore, neither CEL nor the Government has requested domestic or regional preferences for local or regional manufacturers.

Project Supervision

4.15 Because IDB will finance almost all of the civil works for Cerron Grande, the turbo-generator units and installation of all equipment, and because IDB has capability in Washington and will have resident staff in El Salvador to supervise this project, the Bank would leave to IDB the primary responsibility for supervision of construction of the hydro project and implementation of the related resettlement program (see paragraph 4.19). However, the Bank would have the right to review the qualifications of the field personnel proposed by IDB for this supervision prior to their appointment. IDB would leave to the Bank primary responsibility for supervision of CEL's operations. Moreover, the Bank would supervise procurement of all items which it finances and would be solely responsible for supervising the construction of those portions of the Project which it finances and which are not integral parts of the Cerron Grande hydro plant, namely:

- (a) Ahuachapan geothermal plant and related transmission line;
- (b) Transmission lines connecting Cerron Grande to CEL's transmission network at Nejapa substation and to CEL's existing Cinco de Noviembre plant;
- (c) Telemetering center;
- (d) Studies of future projects; and
- (e) Training.

The two institutions have agreed on the text of a Memorandum of Agreement which will contain, among other things, these provisions on Project supervision. It is expected that the Memorandum would be signed shortly after the Executive Directors have approved the proposed loan.

Environmental Aspects

4.16 As indicated in Annex 5, the gases contained in the geothermal steam and noise resulting from its discharge will not menace the environment significantly; their diffusion will be accomplished by construction of 15 to 20 m stacks. After studying the method of conveying the effluent from the geothermal wells proposed by CEL, Bank consultants recommended minor modifications to CEL's

original design, namely, lengthening the canal by 5 km and diffusing the discharge in the ocean by use of a pipe with diffuser ports (see Annex 5). CEL has agreed to these design modifications.

4.17 The Cerron Grande reservoir will flood 13,500 ha of land (see map). According to available information, there are no mineral resources, historical sites or rare species of flora or fauna in the area to be inundated. Based on its own ecological survey and the experience obtained from Cinco de Noviembre reservoir, which is located immediately downstream from Cerron Grande and has shown no adverse ecological effects since its creation more than 20 years ago, Harza has found that the hydro development will not produce detrimental effects on the environment. Except for the resettlement problem (see paragraph 4.19), the consultant's opinion is reasonable.

4.18 The total 13,500 ha of land to be flooded includes 4,400 ha of fertile farm land under intensive cultivation. Creation of the reservoir will necessitate the relocation of a sugar mill and reconstruction of portions of a roadway, including a bridge on the north side of the reservoir, which CEL is prepared to do or have done. The loss of net agricultural return from the loss of crops, principally sugar cane and maize, is estimated at Ø3 million (US\$1.2 million) annually. The economic implications of these effects are examined in Annex 9.

4.19 ~~However, the principal problem resulting from the proposed reservoir involves the relocation and employment of about 10,000 people living in the area to be flooded.~~ For the most part, the affected population consists of small landholders and landless farm workers and their families. The Bank has received and approved the outline of a program for the resettlement and employment of the population displaced by the Cerron Grande reservoir. While resettlement is not a normal function of a power agency, CEL has the financial and managerial capability to implement such a program, either directly or in association with other entities. Accordingly, CEL has agreed to prepare and submit for Bank approval by the end of 1973 detailed plans for the resettlement/employment program and to implement those plans satisfactorily, and the Government has agreed to provide all necessary assistance to CEL to assure successful execution of this program.

4.20 Because of the comparatively large size of the Cerron Grande dam and the large volume of water which its reservoir will hold, CEL has agreed to provide for periodic inspections of the dam and associated structures to ensure that the dam will continue to present no hazard to the environment.



5. JUSTIFICATION OF THE PROJECT

Forecast of Sales and Demand

5.01 During the last ten years, energy consumption in El Salvador has shown an average annual growth rate of 11.5%; Harza has forecast a rate of growth of 11% per year for energy demand through 1984, slightly lower than the past rate of growth. This growth rate appears reasonable.

5.02 Annex 4 shows actual and forecast capacities, demand, generation (by type of plant) and sales related to CEL's installations, net of the relatively small demand met by the private companies' own generating plants, for the period 1965-1980. It is expected that the private companies will continue to use their generating facilities in the present pattern, namely, optimum use of hydro facilities and use of thermal facilities in periods of peak demand. The CEL system yearly load factor increased from 51.5% in 1965 to 56.3% in 1971; it has been assumed that the load factor for the forecast period will be about 57%.

5.03 According to Annex 4 CEL's present installed generating capacity of 199 MW will be able to meet the demand only through 1973. Even with the addition of the 25 MW gas turbine at Acajutla and the 30 MW Ahuachapan Unit 1 in 1973 and 1975, respectively, CEL will have little or no surplus capacity until the completion of Cerron Grande.

5.04 The size of the Ahuachapan unit was determined principally by the estimated capacity of the geothermal field and the plan of utilizing it; it will meet about 1½ years' growth in CEL's demand. The 67.5 MW Cerron Grande units will each satisfy about 2½ years' growth in demand as forecast for the 1976-1978 period.

Least-cost Solution

5.05 CEL's expansion program, which contemplates carrying the two generating plants included in the Project to their ultimate capacity plus a 99 MW conventional steam plant in 1983, was compared with five alternative programs that would meet El Salvador's incremental electricity needs through 1984. As shown in Annex 8, the selected program represents the least-cost solution for meeting those needs for discount rates up to 16%.

Return on the Program Investment

5.06 As indicated in Annex 9, the benefits to the country have been compared with the costs of the least-cost program, which includes completion of the generating facilities begun in the Project, for meeting the country's electricity demands through 1984. The return on the program, rather than the Project, investment has been determined because the Project's two principal elements involve substantial initial expenditures for works common to generating units included in the Project as well as those to be installed later. In this comparison, which equates the benefits to the country with

commercial revenues from electricity sales and which does not quantify certain downstream benefits associated with the Cerron Grande hydro project, the return on the program investment over the hydro project's assumed 50-year life is estimated to be at least 17%.

Employment Effect

5.07 As shown in Annex 10 the Project's direct employment effect for unskilled labor would be positive during the construction period, providing employment for up to 1,500 people per year. The large requirement for unskilled labor for the Cerron Grande civil works is the principal reason for this benefit.

5.08 After completion of the hydro plant the direct effect of the Project would be negative. To offset this negative effect, the resettlement plan (see paragraph 4.19) is expected to provide farm employment for the population displaced by the reservoir. In addition, the Project will produce positive employment effects through the indirect employment resulting from the increased production of electricity.

6. FINANCE

Introduction

6.01 Since 1962 CEL has maintained a relatively high rate of return - from 10.5 to 12 percent - and a conservative financial structure with equity approaching 80 percent of total capital in 1971. This will enable it to self-finance a reasonable portion - about 33 percent - of the Project. A decrease in rate of return after project completion is expected to be temporary, and CEL's financial performance would continue to remain highly satisfactory.

Earnings Record

6.02 CEL's income statements for the years 1969-71 are shown in Annex 12. During this period revenues from sales of energy increased at an average annual rate of 9 percent, and net income at 11 percent. All earnings were retained by CEL and were used to finance a 24% increase in plant, reduce outstanding indebtedness by Ø12 million (US\$4.8 million), and build up cash reserves of Ø7.5 million (US\$3 million).

Capital Structure and Financial Position

6.03 CEL's financial position is sound. Because of its relatively light construction program in 1970 and 1971, CEL has accumulated enough cash to meet its immediate needs. Its relatively low current ratio reflects a heavy repayment schedule of short-term loans and suppliers' credits (incurred principally for installation of Unit 2 at the Acajutla station) through 1972, rather than a lack of current assets. Its debt/equity ratio has steadily declined from 60/40 in 1962 to a conservative 22/78 in 1971, providing a solid base for future borrowing. CEL's assets are stated at original cost. Annex 13 shows CEL's balance sheets for the years 1969-71.

6.04 CEL's books of account at December 31, 1971 did not reflect the various 1971 currency revaluations and did not provide for proper disposition of amounts expended on studies, as explained in Annex 13. CEL has agreed to account for these items in a manner acceptable to the Bank.

6.05 The Bank is CEL's principal creditor; of CEL's total Ø40.1 million (US\$16.0 million) debt, almost 82 percent, or Ø32.7 million (US\$13.1 million), is owed to the Bank. As shown on Annex 11 CEL has also issued long-term bonds guaranteed by the Central Reserve Bank of El Salvador and borrowed from IDB, the Central Reserve Bank and suppliers.

6.06 Two customers - Compania Oriental Salvadorena de Alumbrado Electrico, S. A. (COSAESA), a small distribution company, and Administracion Nacional de Acueductos y Alcantarillados (ANDA), the government's water supply and sewerage agency - have serious arrearages with CEL, including bills up to two years old. The government intends to appoint an intervenor to settle the financial affairs of COSAESA, and thereby settle its arrearages with CEL, which amount to about Ø350,000 (US\$140,000). ANDA, which owed CEL about Ø1 million (US\$400,000)

in mid-1972, has serious financial difficulties and has been able to pay CEL only one-months' billing every two months. The Government has agreed that it will keep current the accounts of all government entities, including ANDA, and that it will pay to CEL ANDA's arrearages over a period not longer than three years.

Financing Plan

6.07 During the six-year project period 1972-77, net internal cash generation will finance approximately 33 percent of CEL's expansion program, plus additions to working capital. This is satisfactory especially in view of the fact that CEL's net plant investment will increase by about 190 percent during the period. Government contributions for village electrification will provide 2 percent of the requirements, and borrowings will be required for the remaining 65 percent. The financing plan is based on CEL's retention and investment of all net income during the Project period, which CEL has agreed to. The following table gives a summary financial plan, details of which are shown in the projected funds statement Annex 14.

FINANCING PLAN FOR 1972-1977

	- - millions - -		<u>Percentages</u>
	<u>Colones</u>	<u>US\$</u>	
<u>Requirement of Funds</u>			
Construction and acquisition program (including interest and fees during construction)			
Fifth Power Project (Soyapango Gas Turbine)	17.5	7.0	5.6
Acajutla gas turbine	6.3	2.5	2.0
Geothermal drilling program	3.0	1.2	1.0
Proposed Sixth Power Project	244.2	97.7	78.2
Village electrification	9.5	3.8	3.0
Future generating expansion	10.5	4.2	3.4
Miscellaneous distribution, general and studies	6.3	2.5	2.0
	<u>297.3</u>	<u>118.9</u>	<u>95.2</u>
Additions to working capital, net	<u>15.1</u>	<u>6.1</u>	<u>4.8</u>
Total requirements	<u>312.4</u>	<u>125.0</u>	<u>100.0</u>
<u>Sources of Funds</u>			
Internal cash generation	152.2	60.9	48.7
Less: debt service (excluding interest and fees during construction)	<u>49.3</u>	<u>19.7</u>	<u>15.8</u>
Net internal cash generation	102.9	41.2	32.9
Contributions for village electrification	6.5	2.6	2.1
Borrowings:			
Existing financing - IDA Credit 227-ES	14.0	5.6	4.5
Proposed loans:			
IDB loan	95.3	38.1	30.5
IBRD loan	68.2	27.3	21.9
Local borrowing	<u>16.0</u>	<u>6.4</u>	<u>5.1</u>
	<u>179.5</u>	<u>71.8</u>	<u>57.5</u>
Future loans for generating expansion	<u>9.5</u>	<u>3.8</u>	<u>3.0</u>
Total borrowings	<u>203.0</u>	<u>81.2</u>	<u>65.0</u>
Total sources	<u>312.4</u>	<u>125.0</u>	<u>100.0</u>

6.08 The proposed Bank loan would be made to CEL for a term of 25 years, including five years of grace, at the current Bank interest rate. It would be guaranteed by the Republic of El Salvador and would finance the foreign cost of:

	- - millions - -	
	<u>¢</u>	<u>US\$</u>
Ahuachapan Unit 1 and related transmission lines	19.8	7.9
Cerron Grande: engineering, diversion works, supply of equipment other than turbo-generator units, and related transmission lines as detailed in Annex 6.	32.7	13.1
Telemetry center	1.3	0.5
Studies	2.5	1.0
Training	0.5	0.2
Interest and commitment fees during construction	<u>11.4</u>	<u>4.6</u>
Total	<u>68.2</u>	<u>27.3</u>

6.09 The interest during construction to be included in the Bank loan was originally estimated by computing interest on: expenditures for the Ahuachapan geothermal project until its estimated completion; and on other expenditures for the loan's five-year grace period. To facilitate loan administration, however, interest and commitment fees would be lent on all Project expenditures only through April 1977; this procedure would result in the same amount of interest as the estimate previously determined and would concentrate it in the period when CEL would need the cash most.

6.10 IDB would make its ¢95.3 million (US\$38.1 million) loan from its Fund for Special Operations to the Republic of El Salvador, which would re-lend the proceeds to CEL. The IDB loan, which El Salvador would repay to IDB in local currency, would be for forty years including ten years of grace at 2 percent annual interest during the amortization period and one percent during the grace period. As detailed in Annex 6, it would finance at the Cerron Grande hydro plant: the foreign cost and part of the local cost of the general contract for civil works (except diversion works) and installation of equipment; the foreign cost of the turbo-generator units; interest during construction (but not commitment fee); and its supervision and inspection fee.

6.11 The government would re-lend the proceeds of the IDB loan to CEL by means of a 25-year loan with five years of grace at interest rates of one percent during the grace period and 5-½ percent during the 20-year

amortization period. IDB will require the government to place the difference between the debt service it receives from CEL and that which it repays to IDB in a National Development Fund.

6.12 IDB's directors have approved the IDB loan. Because successful completion of the Project depends on IDB as well as Bank financing, the Bank should receive notification from IDB that it is prepared to make the initial disbursement from its loan before the proposed loan is effective.

6.13 Besides its internal cash generation and the local-currency component of the IDB loan, CEL requires $\text{Q}16.0$ million (US\$6.4 million) of local borrowing to complete the Project. To provide for unforeseen contingencies as well as those foreseen in the financing plan, the Government has agreed to meet CEL's local financing requirements either directly or by underwriting and guaranteeing bond issues up to $\text{Q}25.0$ million (US\$10.0 million). In the financial projections, the proposed local borrowing is assumed to consist of 5-year bonds at 8% annual interest. These bonds would be issued in 1974-1976 and repaid in five equal annual installments beginning in 1977.

6.14 Before CEL can borrow money or invest its own money in the Project, it must receive approval of its extraordinary budget for the Project from El Salvador's Legislative Assembly, which would follow approval of the proposed loan by the Executive Directors. The loan should not become effective until the Legislative Assembly has approved the extraordinary budget.

6.15 Arrangements have not yet been made for the projected future loans (1976-78) for the foreign cost of future projects.

6.16 The $\text{Q}6.5$ million (US\$2.6 million) government contribution for village electrification represents the IDA Credit 227-ES debt service differential, as explained in paragraph 3.10.

Future Earnings

6.17 CEL's forecast income statement (Annex 12) and key financial ratios (Annex 15) indicate a temporary problem with CEL's rate of return, which will decline from the 10-12% level of 1969-1974 to 6.3% in 1976 and 1977, when the Cerron Grande project will be completed. While this rate of return is below the 9 percent rate of return specified in the current project agreement (IDA Credit 227-ES), it would be acceptable for the few years when Cerron Grande is not operating at full capacity because:

- (i) inclusion of the Cerron Grande hydroelectric plant will approximately double CEL's rate base in 1976-77;
- (ii) inclusion of the special contingency related to goods and services financed by the IDB loan (see paragraph 4.03) adds about $\text{Q}21$ million (US\$8.5 million) to the rate base, increasing it about 6% from what it otherwise would be;

- (iii) CEL's forecast rate of return increases to 7.6 percent in 1978, after the Project is completed, and indications are that CEL will resume earning about 9 percent by 1980, when Cerron Grande will be operating at full capacity; and
- (iv) CEL appears to have no need for additional cash in the years when it will earn a lower return.

The currently effective Project Agreement (IDA Credit 227-ES) requires CEL to effect tariff adjustments to result in a rate of return of at least 9% but contains no provision allowing IDA to waive this requirement. Depending on conditions actually existing at the time, the Bank would consider waiving the tariff requirement during 1976-78; therefore, the Loan Agreement repeats the provision but allows CEL not to make the required adjustment if the Bank agrees.

6.18 CEL's annual debt service coverage will vary from 2.0 to 2.5 times during 1972-77, which is satisfactory. However, its large increase in borrowings related to the Project will result in a less favorable relation of current cash generation to future debt service. CEL has agreed not to incur any indebtedness without the Bank's approval unless its most recent 12-month internal cash generation is at least 1.5 times the maximum debt service requirement for any succeeding fiscal year.

Future Financial Position

6.19 CEL's debt/equity ratio will increase from a low 22/78 in 1971 to about 50/50 at the end of the Project period, which is still quite acceptable. CEL's debt structure, which will continue to consist predominately of long-term debt, will be satisfactory. Its current ratio and working capital will be adequate until 1977, when its cash holdings will increase significantly. Depending on financing requirements for future projects, this cash position may enable CEL to consider tariff reductions after the Project period. Forecast balance sheets and key financial ratios are shown as Annexes 13 and 15, respectively.

7. AGREEMENTS REACHED AND RECOMMENDATIONS

7.01 During negotiations agreements were reached on the following points:

- (a) CEL will have studies performed by consultants acceptable to the Bank to provide for future expansion of its own system and future interconnections with major distribution companies (paragraph 3.05);
- (b) CEL will extend by 5 km and add a diffuser pipe to the canal for effluent of waste water from the Ahuachapan geothermal station into the Pacific Ocean as recommended by the Bank consultant (paragraph 4.16);
- (c) CEL will arrange for periodic inspections of the Cerron Grande dam and associated structures by experts acceptable to the Bank (paragraph 4.20);
- (d) CEL will provide accounting treatment acceptable to the Bank concerning revaluation of its external debt and disposition of studies (paragraph 6.04);
- (e) the Government will pay or cause to be paid on a current basis all amounts owed to CEL by government entities and to pay the arrearages of ANDA to CEL over a period not longer than three years (paragraph 6.06);
- (f) CEL will retain all its net income during the Project period (paragraph 6.07);
- (g) the Government will provide, through underwriting or directly, the local financing necessary to complete the Project (paragraph 6.13);
- (h) CEL will set its electricity rates at a level sufficient to earn at least a 9% return unless the Bank should otherwise agree (paragraph 6.17); and
- (i) CEL will not incur any indebtedness without the Bank's approval unless its internal cash generation is at least 1.5 times its maximum future debt service (paragraph 6.18).

7.02 Before the proposed loan is made effective, the Bank should receive:

- (a) notification that ID3 is prepared to make the initial disbursement from its loan (paragraph 6.12); and
- (b) notification that the Legislative Assembly of El Salvador has approved CEL's extraordinary budget for the Project (paragraph 6.14).

April 11, 1973

APPRAISAL OF SIXTH POWER PROJECT - EL SALVADOR
COMISION EJECUTIVA HIDROELECTRICA DEL RIO LEMPA (CEL)
EL SALVADOR ELECTRIC UTILITIES STATISTICS 1971

<u>Utility</u>	<u>Installed Capacity kW</u>	<u>Number of Retail Consumers</u>	<u>Retail Sales GWh</u>	<u>Bulk Sales GWh</u>	<u>Purchase from CEL GWh</u>	<u>Purchase from Others GWh</u>	<u>Self Generation GWh</u>	<u>Losses - - -</u>	
								<u>GWh</u>	<u>% of Generation and Purchase</u>
CEL-Comision Ejecutiva Hidroelectrica del Rio Lempa	166,075	12,299	27.5	571.2	-	0.2	655.7	57.2	8.7
CAESS-Compania de Alumbrado Electrico de San Salvador	11,804	118,025	459.8	-	484.5	-	19.8	44.5	8.8
CLESA-Compania de Luz Electrica de Santa Ana	3,200	22,682	57.3	0.1	47.4	9.2	9.7	8.9	13.4
CECSA-Compania Electrica de Cucumacayan S.A.	2,268	2	1.8	14.3	-	-	16.7	0.6	3.6
CLES-Compania de Luz Electrica de Sonsonate	830	9,241	18.1	-	10.5	6.3	5.0	3.7	17.0
CLEA-Compania de Luz Electrica de Ahuachapan	895	3,582	3.9	-	3.3	0.1	2.2	1.7	30.4
SPRB-Sucesion Pio Romero Bosque	416	-	-	1.1	-	-	1.1	-	-
DEUSEM-Distribuidora Electrica de Usulután S.E.M.	-	5,561	18.5	-	20.3	-	-	1.8	8.9
COSAESA-Compania Oriental Salvadorena de Alumbrado Electrico S. A.	-	4,519	4.3	-	3.8	1.1	-	0.6	12.2
DESSEM-Distribuidora Electrica de Sensuntepeque S.E.M.	-	1,237	1.1	-	1.4	-	-	0.3	21.4
RMCO-Sociedad Hidroelectrica Roberto de Matheu y Cia	<u>352</u>	<u>733</u>	<u>0.9</u>	<u>0.2</u>	<u>-</u>	<u>-</u>	<u>1.6</u>	<u>0.5</u>	<u>31.3</u>
Total Public Service	185,840	177,881	593.2	586.9	571.2	16.9	711.8	119.8	16.8
Captive Plants	<u>19,864</u>	<u>9</u>	<u>30.9</u> ^{a/}	<u>1.2</u> ^{b/}	<u>-</u>	<u>-</u>	<u>32.1</u>		
GRAND TOTAL FOR COUNTRY	<u>205,704</u>	<u>177,890</u>	<u>624.1</u>	<u>588.1</u>	<u>571.2</u>	<u>16.9</u>	<u>743.9</u>		

a/ Consumption by entity which owns the plant.
b/ Sales to public utilities.

October 1972

ANNEX 1

APPRAISAL OF SIXTH POWER PROJECT - EL SALVADORCOMISION EJECUTIVA HIDROELECTRICA DEL RIO LEMPA (CEL)ELECTRIC POWER TARIFFS IN EL SALVADORRetail Tariffs

1. Retail tariffs of CEL (for its rural electrification zones) and the four largest distribution companies are detailed in the table on page 2, where they are grouped consistently. Rates of the smaller utilities are similar to those shown. In addition, some utilities have special tariffs for particular customers, e.g., street lighting, water supply, other governmental and seasonal service. The special tariffs are basically in accordance with the schedules shown.

2. All retail tariffs have a rational structure with stepped energy rates. The commercial and industrial tariffs (except F5 of CLES) contain a demand charge; generally, this charge is not metered but is calculated on the basis of connected load.

Bulk Tariffs

3. CEL's tariffs to the distribution companies are:
- a. an energy charge of $\text{Q}0.03/\text{kWh}$; and
 - b. a demand charge of $\text{Q}45$ per kW/year to the larger companies (CAESS, CLESA, CLES, CLEA, DEUSEM and DESSEM) and $\text{Q}50$ per kW/year to the smaller companies and the other bulk customers.

Until recently, the demand charge was based on the annual peak; the resultant retroactive billing was a point of contention between CEL and the distribution companies. Under a contract signed with CAESS in September 1972, the demand charge is applied on a monthly basis for the maximum demand in the most recent 12-month period. It is expected that this pattern will be followed in future agreements with other distributors.

EL SALVADOR

RETAIL POWER RATES

(in colones per kWh or kVA, except for minimum bill, which is in colones)

Tariff		UTILITY									
		CEL		CAESS		CLESA		CLES		DEUSEM	
D3	Residential	first 70 kWh	0.12	first 150 kWh	0.08	first 70 kWh	0.12	first 100 kWh	0.11	first 70 kWh	0.12
		next 40 kWh	0.10	next 45 kWh	0.07	next 40 kWh	0.10	next 150 kWh	0.09	next 40 kWh	0.10
		excess kWh	0.05	excess kWh	0.04	excess kWh	0.05	excess kWh	0.04	excess kWh	0.05
		minimum	1.00	minimum (central zone)	1.60	minimum	1.00	minimum	1.00	minimum (urban)	1.00
				minimum (eastern zone)	1.00					minimum (rural)	2.00
G4	Commercial	first 50 kWh/kW	0.15	first 100 kWh/kW	0.11	first 100 kWh/kW	0.14	first 60 kWh/kW	0.18	first 50 kWh/kW	0.17
		next 50 kWh/kW	0.12	next 125 kWh/kW	0.09	next 100 kWh/kW	0.12	next 30 kWh/kW	0.16	next 50 kWh/kW	0.12
		excess kWh	0.05	excess kWh	0.04	next 100 kWh/kW	0.07	next 85 kWh/kW	0.11	excess kWh	0.05
		minimum	3.00	minimum	5.00	excess kWh	0.06	excess kWh	0.04	minimum (urban)	3.00
				minimum	6.00	minimum	6.00	minimum (rural)	6.00		
F5	Industrial (low voltage connection)	first 50 kWh/kW	0.14	first 50 kWh/kW	0.14	first 60 kWh/kW	0.14	first 50 kWh	0.15	first 50 kWh/kW	0.14
		next 50 kWh/kW	0.06	next 50 kWh/kW	0.06	next 40 kWh/kW	0.12	next 80 kWh	0.10	next 50 kWh/kW	0.06
		excess kWh	0.04	excess kWh	0.04	next 75 kWh/kW	0.10	next 100 kWh	0.05	excess kWh	0.04
		minimum	5.00	no minimum	-	excess kWh	0.05	excess kWh	0.04	no minimum	
				minimum	6.00	minimum	7.50	minimum			
F6	Industrial (high voltage connection)	first 100 kWh/kW	0.06	first 100 kWh/kW	0.06	first 100 kWh/kW	0.065	first 100 kWh/kW	0.06	first 100 kWh/kW	0.06
		excess kWh	0.045	excess kWh	0.035	excess kWh	0.05	excess kWh	0.035	excess kWh/kW	0.045
		per kW demand	5.00	per 0-300 kVA	5.25	per kW demand	6.50	per 0-300 kVA	5.25	per kW	5.00
		no minimum	-	excess kVA	4.25	minimum	6.50	excess kVA	4.25	minimum	5.00
				minimum	5.25-4.25			no minimum	-		

October 1972
Revised December 1972

APPRAISAL OF SIXTH POWER PROJECT - EL SALVADOR
COMISION EJECUTIVA HIDROELECTRICA DEL RIO LEMPA (CEL)
INSTALLED CAPACITY OF GENERATING PLANTS IN MW

<u>HYDROELECTRIC</u>	<u>Capacity</u>	<u>Year of Commissioning</u>
5 de Noviembre Plant at Guayabo:		
Unit 1	15.0	1954
Unit 2	15.0	1954
Unit 3	15.0	1957
Unit 4	15.0	1961
Unit 5	<u>21.4</u>	1966
Total 5 de Noviembre	81.4	
Guajoyo Plant at Lake Guija:		
Unit 1	<u>15.0</u>	1963
Total Hydro Plant	<u>96.4</u>	
<u>STEAM-ELECTRIC</u>		
Acajutla Plant:		
Unit 1	30.0	1966
Unit 2	<u>33.0</u>	1969
Total Steam-Electric Plant	<u>63.0</u>	
<u>GAS TURBINE PLANT</u>		
Acajutla free-piston unit	6.6	1965
Soyapango units (2 x 16.5 MW)	<u>33.0</u>	1972
Total Gas Turbine Plant	<u>39.6</u>	
TOTAL INSTALLED CAPACITY	<u>199.0</u>	

October 1972

APPRAISAL OF SIXTH POWER PROJECT - EL SALVADOR
COMISION EJECUTIVA HIDROELECTRICA DEL RIO LEMPA (CEL)
CAPACITIES, CAPABILITIES, SALES AND GENERATION ^{1/}

ACTUAL AND FORECAST

Actual	Required Capacity (MW)			Plant Capabilities (MW)				Surplus Capacity (MW)	Sales (GWh)	Losses incl. Station Supply (GWh)	Generation (GWh)				Total	
	Demand	Reserve	Total	Hydro	Steam	Gasturbines	Geothermal				Total	Hydro	Steam	Gasturbines		Geothermal
1965	73	21.4	94.4	96.4		6.6		103	8.6	316.2	13.5	299.5	30.2			329.7
1966	86	30	116	96.4	30	6.6		133	17.0	374.0	22.3	354.0	42.3			396.3
1967	95	30	125	96.4	30	6.6		133	8.0	419.0	30.8	379.5	70.3			449.8
1968	105	30	135	96.4	30	6.6		133	- 2.0	465.1	36.1	370.3	124.7	6.2		501.2
1969	109	33	142	96.4	63	6.6		166	24.0	499.0	35.8	431.4	101.5	1.9		534.8
1970	121	33	154	96.4	63	6.6		166	12.0	538.4	49.6	416.1	171.9	-		588.0
1971	133	33	166	96.4	63	6.6		166	-	598.7	57.0	439.3	215.8	0.6		655.7
<u>Forecast</u>																
1972	148	33	181	96.4	63	39.6 ^{2/}		199	18.0	671	63	433	294	7		734
1973	164	33	197	96.4	63	64.6 ^{3/}		224	27.0	744	72	398	398	20		816
1974	182	33	215	96.4	63	64.6		224	9.0	827	79	464	422	20		906
1975	202	33	235	96.4	63	64.6	30 ^{4/}	254	19.0	920	94	481	299			1,014
1976	225	67.5	292.5	163.9 ^{5/}	63	64.6	30	321.5	29.0	1,024	102	498	400	27	201	1,126
1977	250	67.5	317.5	231.4 ^{6/}	63	64.6	30	389	71.5	1,140	99	913	114	11	201	1,239
1978	278	67.5	345.5	231.4	63	64.6	30	389	43.5	1,265	123	1,054	123	10	201	1,388
1979	308	67.5	375.5	298.9 ^{7/}	63	64.6	30	456.5	81.0	1,400	137	1,138	188	10	201	1,537
1980	342	67.5	409.5	298.9	63	64.6	30	456.5	47.0	1,560	147	1,150	346	10	201	1,707

- ^{1/} Excluding distributing companies' facilities and demand met thereby.
^{2/} Soyspango 33 MW gas turbine plant (Credit 227-ES) in service December 1972.
^{3/} Soyspango 25 MW gas turbine plant in service March 1973.
^{4/} Ahuechapan first 30 MW geothermal unit assumed in service March 1975.
^{5/} Carron Grande hydro first 67.5 MW unit assumed in service December 1976.
^{6/} Carron Grande hydro second 67.5 MW unit assumed in service March 1977.
^{7/} Carron Grande hydro third 67.5 MW unit assumed in service October 1979.

October 1972
 Revised December 1972
 Revised April 1973

APPRAISAL OF SIXTH POWER PROJECT - EL SALVADORCOMISION EJECUTIVA HIDROELECTRICA DEL RIO LEMPA (CEL)AHUACHAPAN GEOTHERMAL POWER STATIONGeothermal Field

1. CEL has been studying El Salvador's geothermal resources, including the Ahuachapan field, since 1953; UNDP has provided technical and financial assistance to these studies since the late 1960s. Surface studies of an area of about 300 km² in western El Salvador show manifestations of geothermal activity.

2. Within this area, the Ahuachapan geothermal field of about 25 km² was selected for exploratory drilling and for a UNDP-financed pre-feasibility study, performed by Kingston et al. Most of the drilling has been concentrated in an area of about 1 km², 2 km east of the village of Ahuachapan (see map) and 800 m above sea level. At the time of appraisal, eight wells had been drilled; of these, six were producing steam from a layer located at an average depth of 480 m under the surface.

Characteristics of the Geothermal Fluid

3. At the producing layer, water under a pressure of 13-14.6 at.a. and a temperature of around 230°C is found. At the surface, approximately 25% of the enthalpy of 230 kcal/kg can be obtained in form of usable steam and 75% in form of hot water at 100°C with a very high content of salts (mainly silicates and chlorides), which precipitate as the water temperature decreases. A 30 MW installation would produce an amount of water of the order of 0.3 m³/sec. The high boron content (100 p.p.m.) makes this water unsuitable for agricultural or residential uses and requires its disposal to avoid contamination.

4. In the case of Ahuachapan, steam of 7-9 at.a. is obtained by means of a separator located at each wellhead. Within the steam flow, small quantities (0.006% in weight) of noncondensable gases are present of which 94% is CO₂ and 6% is H₂S. The disposal of these gases presents no problem from an ecological point of view. The noise produced by discharges of steam into the air, which will be necessary occasionally for pressure stabilization and well maintenance, is within tolerable limits at 500 m from each wellhead and so it would not affect populated areas.

Field Energy Potential and Initial Installation

5. Based on present information an estimated value for the total potential energy from the field is around 24,000 GWh, of which about one-third can be produced by means of the wells in operation at present. The estimated total energy could be utilized by a generating capacity of around 100 MW operating for 30 years; this figure should be reviewed after a period of operation of the first generating unit and after more wells are drilled in the area.

Initial Installation

6. The initial installation will include:
 - a. At least 4 producing wells (depending on the size of the unit selected, the others will be held in reserve);
 - b. Centrifugal steam separators and silencers at each wellhead;
 - c. Steam piping from each well site to the main header at the power house;
 - d. A power house containing a condensing-type turbo-generator of 30 MW capacity, condensing equipment, and other accessory equipment;
 - e. A 13.8/115 kV transformer of 35 to 45 MVA capacity;
 - f. Outdoor switchyard; and
 - g. A covered 60 km gravitational canal to convey effluent from the plant to the Pacific Ocean.

7. From the wellhead separators, the steam will be conveyed to the main header, from which it will pass through two secondary separators (to reduce the water content to 0.5% in weight) to the condensing-type turbine. The condensers will be of the "mixed flow" type; the cooling water will circulate in closed circuit through cooling towers. Make-up water for the cooling towers will be obtained from streams in the immediate vicinity. The water from the main separators will be discharged to the ocean via the covered canal.

8. A 22 km single-circuit 115 kV transmission line will be constructed from Ahuachapan to CEL's network at Santa Ana. Galvanized steel single-circuit towers and 477 MCM ACSR conductors will be used.

Future Installation

9. Under drilling programs previously completed and presently underway, wells of sufficient capacity to support about 45 MW of generating capacity have been developed. Therefore, CEL expects to cover the requirements of a second medium-pressure (7-9 at.a.) unit of 30-40 MW. At the same time, water from each main separator would then be conveyed to a hot water header in the power house, where a second-stage separator would provide low-pressure (1.5 at.a.) steam for a third generating unit, also of 30-40 MW capacity.

Water Disposal

10. As mentioned in paragraph 3, an adequate water disposal system will be necessary to avoid contamination. Three basic systems were considered for this purpose.

- a. reinjection into the field;

- b. storage during the dry season and discharge into the Paz river during the rainy season; and
- c. continuous discharge into the Pacific Ocean.

System (a) presents several unknowns which could require a long period of tests in order to determine the absorption capacity of the ground and possible saturation due to salt precipitation. System (b) would be sufficient for only the initial installed capacity of 30 MW and would introduce contaminants into an international river. System (c), continuous discharge into the ocean by a means of a gravitational canal, is the system that provides the highest degree of reliability. This canal will be lined and covered by removable pre-cast concrete slabs which would permit inspection and removal of the salt deposits. It will be designed for 1 m³/sec corresponding to the plant's final generating capacity of around 100 MW. The final survey of the canal route is at present underway, and no major obstacles are foreseen for its construction.

11. Bank consultants (Drs. N. Nemerow and R. Faro of Syracuse University), after studying the method selected by CEL of disposing of the effluent and its effect on the ocean environment, have recommended that:

- a. the length of the canal be lengthened from 50 km, as originally designed by CEL, to 55 km, so as to terminate at the ocean rather than at an estuary; and
- b. the effluent be discharged into the ocean by means of a submerged pipeline of about 100 m with diffuser ports.

12. CEL subsequently made further modifications to the canal's route, so that its total length will increase from the 55 km suggested by the consultants to about 60 km.

Cost

13. The estimated cost of the initial 30 MW geothermal installation at Ahucahapan is presented below:

	- Colones (millions)-			- - US\$ (millions)- -		
	<u>Local</u>	<u>Foreign</u>	<u>Total</u>	<u>Local</u>	<u>Foreign</u>	<u>Total</u>
Land and roads	0.25	-	0.25	0.10	-	0.10
Effluent canal including right-of-way	4.50	0.38	4.88	1.80	0.15	1.95
General contract:						
Civil works	2.10	0.90	3.00	0.84	0.36	1.20
Equipment installation	1.05	1.07	2.12	0.42	0.43	0.85
Turbo-generator unit and accessories	-	9.75	9.75	-	3.90	3.90
Piping	-	0.80	0.80	-	0.32	0.32
Crane	-	0.15	0.15	-	0.06	0.06
Fire protection equipment	-	0.25	0.25	-	0.10	0.10
Accessory electric equipment	-	1.85	1.85	-	0.74	0.74
Transmission line to Sta. Ana	0.70	0.85	1.55	0.28	0.34	0.62
Engineering	-	2.20	2.20	-	0.88	0.88
Administration	1.20	-	1.20	0.48	-	0.48
Sub-total	<u>9.80</u>	<u>18.20</u>	<u>28.00</u>	<u>3.92</u>	<u>7.28</u>	<u>11.20</u>
Contingency - Physical	3.43	0.93	4.36	1.37	0.37	1.74
- Price	<u>1.00</u>	<u>0.63</u>	<u>1.63</u>	<u>0.40</u>	<u>0.25</u>	<u>0.65</u>
 Total	<u>14.23</u>	<u>19.76</u>	<u>33.99</u>	<u>5.69</u>	<u>7.90</u>	<u>13.59</u>

14. The estimated foreign cost of the turbo-generator unit and engineering was based on actual bids or contract prices. Because some design details of the plant, particularly the effluent canal, had not been finalized at the time of appraisal, physical contingency allowances of 35% and 15% were applied to the other local and foreign costs, respectively, of the Project. Because most foreign currency project expenditures will be made against firm-price contracts to be signed in 1973, and because price inflation for Salvadoran labor has been minimal in the recent past and is expected to remain so, a price contingency allowance of about 10% should be sufficient to allow for price inflation, including that caused by currency revaluations.

October 1972

Revised December 1972

Revised March 1973

APPRAISAL OF THE SIXTH POWER PROJECT - EL SALVADORCOMISION EJECUTIVA HIDROELECTRICA DEL RIO LEMPA (CEL)CERRON GRANDE HYDROELECTRIC DEVELOPMENTBackground

1. El Salvador has only one major source of hydroelectric energy: the Rio Lempa, whose total energy potential is estimated at 3,500 GWh per year. The Cinco de Noviembre hydro plant at Guayabo (Loans 22-ES, 221-ES and 342-ES), with an annual generation of 400 GWh, was the first installation on the Rio Lempa; the Guajoyo plant with annual generation of 70 GWh, takes water from Lake Guija and discharges into a tributary of the Lempa (see map for plant locations).
2. Subsequent to the installation of the fifth unit at the Cinco de Noviembre plant in 1963, CEL was ready in 1967 to proceed with the next step in the river's development, the Poza del Silencio plant. However, political circumstances prevented the construction of the Poza del Silencio project at the time and necessitated the installation of a second steam unit (33 MW) at Acajutla and two 16.5 MW gas turbine units at Soyapango to meet CEL's requirements. In the ensuing four years CEL and its consultants selected another site about 20 km upstream from the Cinco de Noviembre plant near Cerron Grande.
3. On the Rio Lempa, two sites upstream from Cerron Grande, and two downstream from Cinco de Noviembre, have been identified (see map). Because of a lack of water, the upstream sites both appear uneconomic. Downstream, the EL Tigre site, although large (about 400 MW) and apparently economic, cannot be developed now because its reservoir would inundate Honduran territory as well as Salvadoran. Dry-season regulation, which Cerron Grande would provide, would be required to justify the low-head run-of-river La Pintada project; consequently, this smaller (80 MW) project would appear economic only after completion of Cerron Grande.
4. CEL and its consultants have concluded that Cerron Grande should have a final installed capacity of 270 MW with an annual average generation of 584 GWh, based on a computer simulation of the monthly operation of the system's hydro generating stations for hydrological conditions of 17 years of recorded stream-flows and forecasted future demands. The regulating effect of Cerron Grande's reservoir would increase the annual energy generation of Cinco de Noviembre plant by 142 GWh.

Description

5. The Project, located 40 km northeast of San Salvador at the headwaters of the Cinco de Noviembre reservoir (see map), will consist of:

- a. An earth-and-rock-fill dam across the Rio Lempa;
- b. Spillway on the left bank;
- c. Intakes on the right side of the spillway approach channel connecting to tunnels feeding the turbines;
- d. A surface powerhouse on the left bank; and
- e. A switchyard on the right bank connecting to a double-circuit 115 kV line to San Salvador.

6. The dam will have a maximum height of 85 m and crest at 250 m above sea level; it will require about 6,000,000 m³ of fill; and its crest length will be about 600 m. To the maximum possible extent, the dam will utilize material from required excavation; other materials, including impervious core materials, are available within a few kilometers of the dam site. The dam will form a reservoir with the following dimensions at El 243 m, its maximum operating level:

- a. Surface area - 135 km²;
- b. Length - 35 km upstream from dam site;
- c. Storage - 1,430 million m³ between operating limits at El 228 m to El 243 m, plus 750 million m³ below El 228 m.

7. The spillway, which will be founded on rock, will consist of a control structure with four radial gates, each 15 m by 12.2 m, a chute and a flip bucket. With the normal maximum reservoir level at El 243 m, the spillway will have the capacity to discharge about 6,500 m³/sec, equal to inflow which would occur once every 50 years. For larger floods, the reservoir will provide storage up to El 249.4 m, and the spillway will then discharge about 11,000 m³/sec. This is designed for protection against the probable maximum flood.

8. The power facilities will consist of two intakes, two pressure tunnels, and a powerhouse with two 67.5 MW units. Minimum provisions will be made for adding two additional 67.5 MW units in the future. The vertical-shaft Francis-type turbines will each be rated at 94,100 metric horsepower, 144 rpm at 57 m net head. The generators will be rated 75,000 kVA and 0.9 power factor. The generators will be connected to individual step-up transformers, type FOA, rated 86,000 kVA, 13.8 kV.

9. A transmission line about 34 km long will be built from the switchyard, located across the river from the powerhouse, to Nejapa substation, near San Salvador. The line will be double-circuit, 115 kV, on self-supporting galvanized steel double circuit towers. The conductor will be 477 MCM ACSR. In addition, a single-circuit, three-phase 115 kV line will be built on single-circuit towers from Cerron Grande substation to the Cinco de Noviembre substation about 20 km away. The conductor will also be 477 MCM ACSR.

Estimated Cost

10. As indicated in the table below, the cost of the plant and related transmission lines was estimated on the basis of international bidding, with appropriate contingencies (see paragraph 11) added.

	Colones (millions)			US\$ (millions)		
	<u>Local</u>	<u>Foreign</u>	<u>Total</u>	<u>Local</u>	<u>Foreign</u>	<u>Total</u>
Land	16.20	-	16.20	6.48	-	6.48
Sugar mill relocation	2.50	-	2.50	1.00	-	1.00
New roads & bridges	5.60	-	5.60	2.24	-	2.24
Housing for population displaced by reservoir	9.00	-	9.00	3.60	-	3.60
Total land & relocation	<u>33.30</u>	-	<u>33.30</u>	<u>13.32</u>	-	<u>13.32</u>
Operators' village	1.10	-	1.10	0.44	-	0.44
Subsoil exploration	0.38	-	0.38	0.15	-	0.15
Access roads	2.37	-	2.37	0.95	-	0.95
Diversion works	1.20	1.10	2.30	0.48	0.44	0.92
General contract	24.67	34.48	59.15	9.87	13.79	23.66
Gates & hoists	0.13	5.65	5.78	0.05	2.26	2.31
Floating bulkhead	0.37	0.38	0.75	0.15	0.15	0.30
Turbines & governors	0.13	6.07	6.20	0.05	2.43	2.48
Generators	0.13	5.32	5.45	0.05	2.13	2.18
Transformers	0.02	0.98	1.00	0.01	0.39	0.40
Accessory electric equipment	0.25	2.37	2.62	0.10	0.95	1.05
Powerhouse crane	0.03	1.10	1.13	0.01	0.44	0.45
Transmission lines	1.37	1.78	3.15	0.55	0.71	1.26
Engineering	0.88	15.27	16.15	0.35	6.11	6.46
Administration	5.62	-	5.62	2.25	-	2.25
Sub-total	<u>71.95</u>	<u>74.50</u>	<u>146.45</u>	<u>28.78</u>	<u>29.80</u>	<u>58.58</u>
Contingency-physical	6.62	5.33	11.95	2.65	2.13	4.78
-price	-	9.12	9.12	-	3.65	3.65
Special contingency for IDB member country procurement	-	<u>21.35</u>	<u>21.35</u>	-	<u>8.54</u>	<u>8.54</u>
Total	<u>78.57</u>	<u>110.30</u>	<u>188.87</u>	<u>31.43</u>	<u>44.12</u>	<u>75.55</u>

11. Allowances for physical contingencies, price escalation and special procurement were computed as follows:

- a. Physical contingencies of between 5 and 15% have been applied to each cost component except engineering and administration. The resulting overall physical contingency allowance is about 10% for local and 9% for foreign costs.
- b. Price escalation of foreign costs was computed using a 4% annual escalation rate. An additional price contingency allowance of 10% was included for Project elements subject to worldwide competitive bidding. The resulting overall price contingency is about 12.5% of the estimated foreign cost.

This should be sufficient to allow for price inflation, including that caused by possible currency revaluations. Sufficient allowances have been made in the base cost estimates to provide for escalation of local labor costs, which has been minimal in El Salvador during the past several years.

- c. Because goods and services financed by IDB must be obtained from its member nations, special allowances have been included for such restricted procurement based on IDB's experience in similar procurements. These special contingencies are 50% of the foreign cost plus normal contingencies for the general contract, or US\$7.58 million; and 20% for turbo-generator units, or US\$0.96 million.

Financing

12. The proposed IDB loan would finance about 71% of the foreign and 19% of the local currency requirements of the Cerron Grande hydro plant, plus interest during construction and supervision fee, as below:

	- - -millions - - -	
	<u>¢</u>	<u>US\$</u>
<u>Direct construction costs</u>		
Foreign currency:		
General contract	34.48	13.79
Turbines and governors	6.07	2.43
Generators	5.32	2.13
Special contingency for IDB member-country procurement	21.35	8.54
Other contingencies	10.28	4.11
Total foreign	<u>77.50</u>	<u>31.00</u>
Local currency:		
General contract	14.80	5.92
Total direct cost	<u>92.30</u>	<u>36.92</u>
<u>Interest and fees during construction</u>		
Interest during construction - foreign	1.85	0.74
Interest during construction - local	0.20	0.08
Inspection and supervision fee	0.90	0.36
Total financing costs	<u>2.95</u>	<u>1.18</u>
Total	<u>95.25</u>	<u>38.10</u>

13. The proposed Bank loan would finance the balance of Cerron Grande's foreign costs, as below:

	- - - millions - - -	
	<u>¢</u>	<u>US\$</u>
Diversion works	1.10	0.44
Gates and hoists	5.65	2.26
Floating bulkhead	0.38	0.15
Transformers	0.98	0.39
Accessory electric equipment	2.37	0.95
Powerhouse crane	1.10	0.44
Transmission lines	1.78	0.71
Engineering	15.27	6.11
Contingencies	4.17	1.67
Total	<u>32.80</u>	<u>13.12</u>

14. CEL would finance the remaining local costs of \$63.77 million (US\$25.51 million) from its own resources and through local borrowing.

Procurement

15. Procurement of those items financed by IDB - the general contract for construction of civil works and installation of equipment, and contracts for turbines and governors and for generators - would be in accordance with IDB's regulations; it would be restricted to firms in IDB member countries.

16. For items financed by the Bank, procurement has been or would be in accordance with Bank guidelines, open to all member countries of the Bank plus Switzerland. Bank-financed procurement would consist of:

- a. A contract, already let, for construction of diversion works;
- b. Two supply-and-erect contracts for the transmission lines; and
- c. Nine contracts for the supply of accessory equipment.

November 1972

Revised January 1973

APPRAISAL OF SIXTH POWER PROJECT - EL SALVADOR

COMISION EJECUTIVA HIDROELECTRICA DEL RIO LEMPA (CEL)

ESTIMATED SCHEDULE OF LOAN DISBURSEMENTS

(in thousands of US dollars)

ASSUMPTIONS

Loan Signing: April 1973
 Effective Date: July 1973
 Closing Date: March 31, 1978

<u>IBRD Fiscal Year and Quarter</u>	<u>Disbursements during Quarter</u>	<u>Cumulative Disbursements at End of Quarter</u>
Year Ending June 30, 1974:		
September 30, 1973	2,900	2,900
December 31, 1973	2,100	5,000
March 31, 1974	2,100	7,100
June 30, 1974	2,200	9,300
Year Ending June 30, 1975:		
September 30, 1974	2,200	11,500
December 31, 1974	2,200	13,700
March 31, 1975	1,900	15,600
June 30, 1975	1,900	17,500
Year Ending June 30, 1976:		
September 30, 1975	1,900	19,400
December 31, 1975	2,000	21,400
March 31, 1976	1,100	22,500
June 30, 1976	1,200	23,700
Year Ending June 30, 1977:		
September 30, 1976	1,200	24,900
December 31, 1976	1,200	26,100
March 31, 1977	300	26,400
September 30, 1977	300	26,700
Year Ending June 30, 1978:		
September 30, 1977	300	27,000
December 31, 1977	300	27,300
March 31, 1978	-	27,300

November 1972
 Revised December 1972
 Revised March 1973

APPRAISAL OF SIXTH POWER PROJECT - EL SALVADOR
COMISION EJECUTIVA HIDROELECTRICA DEL RIO LEMPA (CEL)
COMPARISON OF ALTERNATIVE POWER PROGRAMS 1974-1984

1. From the many possible programs to meet El Salvador's incremental electricity requirements through 1984, the six most practical have been selected for comparison. The six programs, which are shown in the table on page 2 of this annex, are based on different combinations of the following types of generating units:

- i. 30 MW geothermal units to be installed at Ahuachapan, with a final capacity of 90 MW.
- ii. 67.5 MW hydroelectric units to be installed at Cerron Grande, with a final capacity of 270 MW.
- iii. 33, 66 and 99 MW oil-fired steam units to be installed at suitable places on the Pacific coast.

The characteristics of the selected units take into account the size of the system to be served and the efficient utilization of available resources.

2. The assumptions concerning capital, fuel and annual operating and maintenance (O&M) costs for each type of unit included in the comparison are shown on page 3. All costs exclude taxes, since CEL pays no taxes. Local unskilled labor, which is underutilized in El Salvador, has been shadow-priced at 50% of its cost.

3. The resulting cost streams for the six programs for the period 1974-2024, which covers the assumed useful life of the hydroelectric plant, are shown on page 4. A useful life of 25 years has been assumed for steam-electric and geothermal plants; each unit of this type has been replaced with like and kind at the end of its assumed useful life in the computations. Residual values of the remaining facilities have been treated as a negative cost at the end of the period.

4. The present worth of each program has been calculated for annual discount rates from 5 to 20%. As shown on the graph (page 5 of this annex), which shows the differences among the programs' net present worths, the recommended Program A is the least-cost solution for discount rates up to about 16%.

5. In a separate calculation, the assumed price of fuel was reduced by 10% for the two least-cost programs (the recommended Program A and the all steam-electric Program F). The results of this comparison were similar to the comparison of the six programs: the recommended program, denoted A' on the graph, is the preferable program for discount rates up to about 14.5% when compared to the next-best alternative, denoted F'.

ALTERNATIVE GENERATION EXPANSION PROGRAMS

<u>Year</u>	<u>Program A</u> (Basic Program)	<u>Program B</u> (Geothermal 2nd Stage postponed)	<u>Program C</u> (Cerron Grande postponed)	<u>Program D</u> (Geothermal postponed)	<u>Program E</u> (Geothermal eliminated)	<u>Program F</u> (All Steam)
1974	30 MW Ahuachapan	30 MW Ahuachapan	30 MW Ahuachapan	33 MW Steam	33 MW Steam	33 MW Steam
1975						
1976	135 MW Cerron Grande	135 MW Cerron Grande	66 MW x 2 Steam	30 MW Ahuachapan	135 MW Cerron Grande	66 MW x 2 Steam
1977				135 MW Cerron Grande		
1978						
1979	67.5 MW Cerron Grande	67.5 MW Cerron Grande	135 MW Cerron Grande		67.5 MW Cerron Grande	66 MW Steam
1980				67.5 MW Cerron Grande		
1981	30 MW x 2 Ahuachapan	66 MW Steam			66 MW Steam	66 MW Steam
1982				66 MW x 2 Steam		
1983	99 MW Steam	99 MW Steam	67.5 MW Cerron Grande		99 MW Steam	66 MW Steam
1984	67.5 MW Cerron Grande	67.5 Cerron Grande	99 MW Steam	67.5 MW Cerron Grande	67.5 MW Cerron Grande	99 MW Steam
1985	Future Project	Future Project	Future Project	Future Project	Future Project	Future Project

COST ASSUMPTIONS

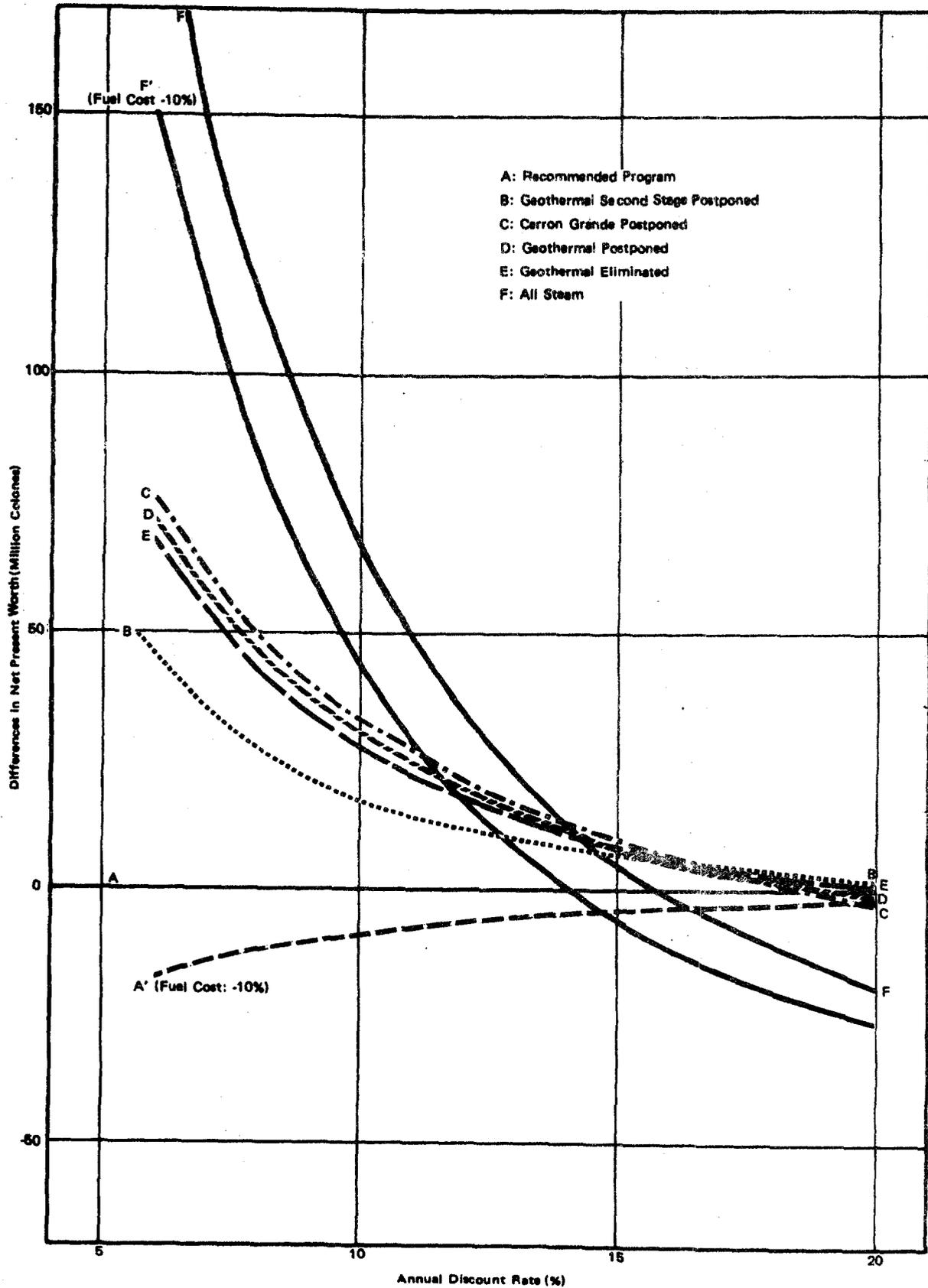
<u>Items</u>	<u>Values</u>
1. Construction Cost	
Geothermal No. 1	Ø 37.5 million (US\$500/kW)
No. 2 & 3	Ø 48.6 million (US\$324/kW)
Steam 33 MW	US\$ 280/kW
66 MW	US\$ 250/kW
99 MW	US\$ 200/kW
Cerron Grande No. 1 & 2	Ø 169 million
No. 3	Ø 19.3 million
No. 4	Ø 21.2 million
2. Annual O & M Cost	
Geothermal	Construction cost x .03
Steam	Construction cost x .015
Cerron Grande 1,2	Ø 0.99 million
+3	Ø 1.21 million
+4	Ø 1.40 million
3. Fuel Cost	
Bunker C oil	US\$ 3.75/barrel
Light Diesel oil	US\$ 4.60/barrel
Heat rate 33 MW Steam	12,000 Btu/kWh
66 MW Steam	11,000 Btu/kWh
99 MW Steam	10,200 Btu/kWh
Gas turbine	15,000 Btu/kWh
Fuel Cost 33 MW Steam	Ø 1.94 x 10 ⁻² /kWh
66 MW Steam	Ø 1.77 x 10 ⁻² /kWh
99 MW Steam	Ø 1.65 x 10 ⁻² /kWh
Gas turbine	Ø 3.30 x 10 ⁻² /kWh

PROJECTED COST STREAM

(in millions of colones)

	<u>Program A</u>	<u>Program B</u>	<u>Program C</u>	<u>Program D</u>	<u>Program E</u>	<u>Program F</u>
1972	7.85	7.85	5.59	2.41	4.57	2.41
1973	20.83	20.83	8.55	9.16	19.28	7.00
1974	61.13	61.13	27.24	31.69	56.21	22.32
1975	66.66	66.66	38.84	60.97	64.91	34.93
1976	50.46	50.46	70.72	85.68	53.08	61.06
1977	22.48	22.48	54.46	57.55	25.35	18.82
1978	19.71	12.34	69.34	22.87	15.21	29.41
1979	26.13	19.33	57.93	13.35	22.20	48.47
1980	32.56	20.93	24.99	26.91	23.80	35.95
1981	24.31	42.81	13.86	37.20	45.45	55.86
1982	26.71	32.47	27.41	68.02	35.34	48.55
1983	53.40	58.66	44.03	28.35	61.30	74.70
1984	28.04	33.79	53.46	35.11	36.66	69.27
1985-98	23.03	28.59	28.40	29.91	31.46	44.35
1999	60.53	66.09	65.90	53.04	54.59	67.48
2000	23.03	28.59	28.40	29.91	31.46	44.35
2001	23.03	28.59	111.00	67.41	31.46	126.95
2002-03	23.03	28.59	28.40	29.91	31.46	44.35
2004	23.03	28.59	28.40	29.91	31.46	85.65
2005	23.03	28.59	28.40	29.91	31.46	44.35
2006	71.63	69.89	28.40	29.91	72.76	85.65
2007	23.03	28.59	28.40	112.51	31.46	44.35
2008	72.59	78.15	28.40	29.91	81.02	85.65
2009	23.03	28.59	77.96	29.91	31.46	93.91
2010-24	23.03	28.59	28.40	29.91	31.46	44.35
Residual value	-21.33	-13.96	-18.64	-15.85	-10.76	-16.77

APPRAISAL OF SIXTH POWER PROJECT - EL SALVADOR
ECONOMIC COMPARISON OF PROGRAMS FOR EXPANSION OF
ELECTRIC POWER SUPPLY FOR THE PERIOD 1974-1985



APPRAISAL OF SIXTH POWER PROJECT - EL SALVADOR

COMISION EJECUTIVA HIDROELECTRICA DEL RIO LEMPA (CEL)

RETURN ON THE PROGRAM INVESTMENT

1. Both generating facilities included in the Project involve substantial initial expenditures for works common to generating units included in the Project as well as those to be installed later. To be specific, the geothermal plant includes a canal designed for generating capacity three times the 30 MW to be installed initially; the ultimate capacity of the Cerron Grande hydro plant is double the 135 MW included in the Project. It is for this reason that the return on the program, rather than the Project, investment has been determined. In this determination, the benefits to the country have been compared with the costs of the program selected as the least-cost solution of meeting El Salvador's incremental electricity needs for the period 1974-84 (see Annex 8). This comparison has been extended over the assumed useful life (50 years) of the hydroelectric project.

Project Benefits

2. To establish the minimum value of the program benefits, revenues have been determined by applying an estimated retail tariff of 0.07 (US\$0.028)/kWh to the generation of the Ahuachapan and Cerron Grande plants' final capacities, plus the additional energy which will be produced at Cinco de Noviembre as a result of increased regulation provided by the Cerron Grande dam, less transmission and distribution losses.

3. While Cerron Grande is not a flood control project, its regulating capacity will provide additional downstream benefits, including:

- a. Reduction of flood losses;
- b. Possibilities of increased agricultural production in the lower Lempa basin; and
- c. Increased potential generation of future hydro projects.

The computations have not taken these benefits into account.

Project Costs

4. The capital costs of the two generating plants and related transmission lines used in this determination are those estimated in the appropriate feasibility studies at world-market prices and consequently do not reflect minor modifications made by the appraisal team or the special allowance for IDB member-country procurement. In addition, estimated costs of distribution facilities to convey the energy to the retail consumer have been included. Facilities have been replaced with like and kind at the end of their assumed useful lives.

5. Incremental operating and maintenance costs have been estimated for each plant and for transmission based on the consultants' studies, and for distribution based on the distribution companies' experience.

6. About 4,400 ha of the 13,500 ha to be inundated by the Cerron Grande reservoir is intensively cultivated, principally with sugar cane. The loss in net agricultural return because of Cerron Grande is estimated at 03 million (US\$1.2 million) annually; this loss is reflected as a project cost in the estimated price of the land. Also included in the hydro project's capital costs are the value of the houses to be inundated and the cost of relocating the sugar mill.

Income Transfers

7. As detailed in paragraph 6.10 of the report, the IDB loan would be on soft terms, which would compensate for the increased investment cost caused by restricted IDB member-country procurement even if that cost were to double. Under the assumption that El Salvador would have obtained this net transfer for another project if the Cerron Grande project had not been available, the increased investment costs, which represent only income transfers between countries, have not been introduced into the estimated return on program investment.

Return on the Investment

8. As shown on the accompanying table, the return on the program's investment is estimated to be at least 17%.

RETURN ON THE AHUACHAPAN AND CERRON GRANDE INVESTMENTS

(in 1972 prices - thousands of colones)

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985-95	1996	1997	1998	1999	2000-2002	2003-2026
Generated Energy, GWh																				
Ahuachapan	-	-	-	201	201	201	201	201	201	603	603	603	603	603	603	603	603	603	603	603
Cerron Grande ^{a/}	-	-	-	-	-	389	522	632	644	654	664	674	684	694	694	694	694	694	694	694
Sub-total	-	-	-	201	201	590	723	833	845	1,257	1,267	1,277	1,287	1,297	1,297	1,297	1,297	1,297	1,297	1,297
Transmission Losses @ 6%	-	-	-	13	13	32	43	50	51	75	76	77	77	78	78	78	78	78	78	78
Energy Sold by CEL to Distribution Companies	-	-	-	188	188	555	680	783	794	1,182	1,191	1,200	1,210	1,219	1,219	1,219	1,219	1,219	1,219	1,219
Energy Revenues @ Average Retail Tariff of Col 70/MWh	-	-	-	13.2	13.2	38.5	47.6	54.6	55.6	82.7	83.4	84.0	84.7	85.3	85.3	85.3	85.3	85.3	85.3	85.3
Distribution Losses @ 5%	-	-	-	1.2	1.2	3.4	4.3	4.9	5.0	7.4	7.5	7.6	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.7
Distribution Costs	-	-	-	0.3	0.3	1.0	1.2	1.4	1.4	2.1	2.1	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Current @ Col 2/MWh	-	-	-	2.8	15.4	12.6	12.6	-	-	-	-	-	-	-	-	-	-	-	-	-
Capital	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PROJECT BENEFITS	-	-	(2.8)	(3.7)	(0.9)	21.5	29.5	48.3	49.2	73.2	73.8	74.2	74.9	75.4	75.4	75.4	72.6	60.0	62.8	75.4
OPERATION & MAINTENANCE COSTS																				
Transmission @ Col 2/MWh	-	-	-	0.3	0.3	1.0	1.2	1.4	1.4	2.1	2.1	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Generation - Ahuachapan	-	-	-	0.8	0.8	0.8	0.8	0.8	0.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cerron Grande	-	-	-	-	-	0.8	0.9	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Sub-total	-	-	-	1.1	1.1	2.6	2.9	3.3	3.3	4.3	4.3	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
NET OPERATING INCOME	-	-	(2.8)	(4.8)	(2.0)	18.9	26.6	45.0	45.9	68.9	69.5	69.8	70.5	71.0	71.0	71.0	68.2	55.6	58.4	-
CAPITAL COSTS																				
Ahuachapan including transmission lines	6.0	8.0	19.0	5.0	-	-	7.0	11.0	24.0	6.0	-	-	-	-	10.5	16.5	36.0	9.0	-	-
Cerron Grande including transmission and land	2.0	12.0	40.0	52.0	38.0	19.0	16.0	20.0	-	-	-	-	-	-	-	-	-	-	-	-
NET BENEFITS (DEFICITS)	(8.0)	(20.0)	(61.8)	(61.8)	(40.0)	(0.1)	3.6	14.0	21.9	62.9	69.5	69.8	70.5	71.0	60.5	54.5	32.2	46.6	58.4	71.0

^{a/} Includes additional generation at Cinco de Noviembre attributable to Cerron Grande.

Rate of Return = 16.7%

APPRAISAL OF SIXTH POWER PROJECT - EL SALVADOR

COMISION EJECUTIVA HIDROELECTRICA DEL RIO LEMPA (CEL)

NET EMPLOYMENT EFFECT ON UNSKILLED LABOR FROM AHUACHAPAN AND CERRON GRANDE PROJECTS

(in man-years)

	<u>----- New Jobs -----</u>				<u>Approximate Number of Dislocated Farmers ^{a/}</u>	<u>Net Effect</u>
	<u>Ahuachapan</u>	<u>Cerron Grande</u>	<u>Farming</u>	<u>Total</u>		
1973	500	1,400	-	1,900	400	1,500
1974	500	1,400	-	1,900	400	1,500
1975	-	1,400	-	1,400	900	500
1976	-	1,400	-	1,400	1,300	100
1977 onwards	-	100	400 ^{b/}	500	1,700	- 1,200 ^{c/}

^{a/} Assuming every sixth person of the present area population of 10,000 employed.

^{b/} 250 farmers employed in the project area during reservoir drawdown and 150 farmers employed downstream.

^{c/} To be offset by the resettlement program.

December 1972
Revised March 1973

APPRAISAL OF SIXTH POWER PROJECT - EL SALVADOR
COMISION EJECUTIVA HIDROELECTRICA DEL RIO LEMPA (CEL)
LONG-TERM DEBT AT DECEMBER 31, 1971

(in thousands)

<u>LENDER AND PROJECT</u> <u>IBRD/IDA</u>	<u>LOAN</u> <u>DATE</u>	<u>ORIGINAL AMOUNT</u>		<u>OUTSTANDING AT DECEMBER 31, 1971</u>			
		<u>¢</u>	<u>US\$</u>	<u>BEFORE REVALUATION</u>		<u>AFTER REVALUATION</u>	
				<u>¢</u>	<u>US\$</u>	<u>¢</u>	<u>US\$</u>
22-ES Guayabo Hydro	1949	31,362	12,545	7,753	3,101	7,819	3,128
221-ES Guayabo Expansion	1959	6,757	2,703	4,727	1,891	5,086	2,034
263-ES Guajoyo Hydro	1960	8,680	3,472	6,580	2,632	6,631	2,652
342-ES System Expansion	1963	14,847	5,939	11,567	4,627	13,194	5,278
Credit 227-ES Soyapango Gas Turbine	1971	14,000	5,600	-	-	-	-
Total IBRD/IDA				30,627	12,251	32,730	13,092
<u>Bonds Guaranteed by Central Reserve Bank of El Salvador</u>	1950-55	13,100	5,240	3,234	1,294	3,234	1,294
<u>Loans from Central Reserve Bank of El Salvador</u>							
LP-3 Relending of IDB pilot rural electrification loan	1962-63	457	183	418	167	418	167
LP-85	1969-71	5,000	2,000	2,500	1,000	2,500	1,000
Total Central Bank Loans				2,918	1,167	2,918	1,167
<u>Suppliers Credits - Mitsubishi</u>	1966-67	2,795	1,118	1,005	402	1,206	482
Total Long-term Debt				37,784	15,114	40,088	16,035

APPRAISAL OF SIXTH POWER PROJECT - EL SALVADOR
COMISION EJECUTIVA HIDROELECTRICA DEL RIO LEMPA (CEL)

ESTIMATED DEBT SERVICE 1972-1978

(Thousands of Colones)

	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>
INTEREST							
Existing loans:							
IBRD Loan 22-ES	310	220	125	26			
IBRD Loan 221-ES	288	272	253	235	215	194	172
IBRD Loan 263-ES	377	358	339	317	296	272	248
IBRD Loan 342-ES	714	669	623	573	519	465	406
IDA Credit 227-ES	466	1,008	977	944	908	870	829
1975 bonds guaranteed by Central Bank	151	107	60	12			
Central Reserve Bank Loan LP-3	18	17	16	15	14	13	12
Central Reserve Bank Loan LP-85	128						
Mitsubishi credits	<u>55</u>	<u>13</u>					
Total existing loans	<u>2,507</u>	<u>2,664</u>	<u>2,393</u>	<u>2,122</u>	<u>1,952</u>	<u>1,814</u>	<u>1,667</u>
Proposed loans:							
IDB Loan: interest and fees		625	713	815	947	1,028	5,240
IBRD Loan		685	1,957	3,224	4,173	4,811	4,948
Local borrowing			<u>330</u>	<u>860</u>	<u>1,170</u>	<u>1,152</u>	<u>896</u>
Total proposed loans		<u>1,310</u>	<u>3,000</u>	<u>4,899</u>	<u>6,290</u>	<u>6,991</u>	<u>11,084</u>
Future loans					<u>72</u>	<u>404</u>	<u>1,031</u>
Total Interest	<u>2,507</u>	<u>3,974</u>	<u>5,393</u>	<u>7,021</u>	<u>8,314</u>	<u>9,209</u>	<u>13,782</u>
AMORTIZATION							
Existing loans:							
IBRD Loan 22-ES	2,118	2,208	2,303	1,190			
IBRD Loan 221-ES	288	304	323	341	361	382	404
IBRD Loan 263-ES	319	338	357	379	400	424	448
IBRD Loan 342-ES	802	847	893	943	997	1,051	1,110
IDA Credit 227-ES		413	450	487	513	562	588
1975 bonds	877	915	954	488			
Central Reserve Bank Loan LP-3	21	22	23	23	24	25	26
Central Reserve Bank Loan LP-85	2,500						
Mitsubishi credits	<u>671</u>	<u>535</u>					
Total existing loans	<u>7,596</u>	<u>5,582</u>	<u>5,303</u>	<u>3,851</u>	<u>2,295</u>	<u>2,444</u>	<u>2,576</u>
Proposed loans:							
IDB loan							2,675
IBRD loan							1,570
Local borrowing						<u>3,200</u>	<u>3,200</u>
Total proposed loans						<u>3,200</u>	<u>7,445</u>
Total Amortization	<u>7,596</u>	<u>5,582</u>	<u>5,303</u>	<u>3,851</u>	<u>2,295</u>	<u>5,644</u>	<u>10,021</u>

November 1972
 Revised December 1972
 Revised March 1973

APPRAISAL OF SIXTH POWER PROJECT - EL SALVADOR
COMISION EJECUTIVA HIDROELECTRICA DEL RIO LEMPA (CEL)
ACTUAL AND FORECAST INCOME STATEMENTS 1969-1978

(in thousands of colones)

	Actual			Forecast						
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Operating revenues:										
Sales in GWh	499.0	538.8	598.3	671.0	744.0	827.0	920.0	1,024.0	1,140.0	1,266.0
Average revenue per kWh (in centavos)	4.04	4.06	4.04	4.00	3.95	3.94	3.93	3.92	3.91	3.90
Operating revenues from sales	20,172	21,865	24,187	26,840	29,388	32,584	36,156	40,141	44,574	49,374
Other operating revenues	5	5	8	-	-	-	-	-	-	-
Total operating revenues	20,177	21,870	24,195	26,840	29,388	32,584	36,156	40,141	44,574	49,374
Operating expenses:										
Depreciation	3,121	3,596	4,176	4,288	5,680	6,123	8,129	8,267	12,212	12,125
Fuel	855	1,401	1,765	2,703	3,963	4,166	6,372	8,030	2,383	2,518
Labor	2,833	2,472	2,629	2,745	2,867	3,350	3,494	4,056	4,231	4,414
Other operating expenses	445	899	1,554	1,200	1,555	1,603	1,894	2,084	1,967	1,983
Total operating expenses	7,254	8,368	10,124	10,936	14,065	15,242	19,889	22,437	20,853	21,040
Net income from operations	12,923	13,502	14,071	15,904	15,323	17,342	16,267	17,704	23,721	28,334
Non-operating income	71	416	86	275	300	100	-	-	500	1,000
Net income before interest	12,994	13,918	14,157	16,179	15,623	17,442	16,267	17,704	24,221	29,334
Interest paid	2,857	2,433	2,282	2,507	3,974	5,393	7,021	8,314	9,209	13,782
Less: interest charged to construction	592	339	338	466	1,310	2,670	4,239	5,992	2,771	1,031
Interest charged to income	2,265	2,094	1,944	2,041	2,664	2,723	2,782	2,322	6,438	12,751
Net income	10,729	11,824	12,213	14,138	12,959	14,719	13,485	15,382	17,783	16,583
Equity:										
Equity at beginning of year	78,597	89,262	100,947	112,748	126,886	141,145	157,164	171,949	188,631	207,714
Contributions of capital ^{1/}	-	-	-	-	1,300	1,300	1,300	1,300	1,300	1,300
Other (charges) or credits	(64)	(139)	(412)	-	-	-	-	-	-	-
Equity at end of year	89,262	100,947	112,748	126,886	141,145	157,164	171,949	188,631	207,714	225,597

^{1/} Contributions by government for rural electrification.

ASSUMPTIONS USED IN FORECASTS 1972-1978Sales and Revenues:

GWh sales	- Average annual increase - 11%
Average revenue per kWh	- 1971 - 4.04 centavos
	1972 - 4.00) reflecting elimination of
	1973 - 3.95) retroactive demand charge
	beginning 1972
	1974 and on-decreasing by 0.01 centavo
	annually

Depreciation:

<u>Type of Property</u>	<u>Annual Straight-line Rate</u>
Hydro production	2.0%
Geothermal production	4.0
Gas turbine	5.0
Telemetering center equipment	3.5
Village electrification	3.5
Other distribution	3.0

<u>Fuel</u>	<u>Price per barrel</u>		<u>Price per million</u>
	<u>¢</u>	<u>US\$</u>	<u>BTU - US\$</u>
Bunker C oil: through 1974	4.40	1.76	0.32
1975-1978	9.38	3.75	0.69
Light diesel	11.50	4.60	0.89

Operating personnel:

	<u>Professional</u>	<u>Non-professional</u>
Number of personnel - 1972	197	437
Annual increase in personnel (except new generating plants) - percent	1%	1%
Number of personnel - Ahuachapan geothermal unit 1 (beginning 1974)	15	38
Number of personnel - Cerron Grande units 1 and 2 (beginning 1976)	31	81
Average 1971 salary - colones	7,512	2,688
Average annual salary increase in forecast period - percent	3%	4%

Other operating costs:

For maintenance of thermal generating facilities	- ¢0.002/kWh of non-hydro generation
For other operating costs	- ¢3,600/MW of installed capacity

Non-operating income:

Annual interest rate applied to
estimated excess cash balances - percent - 5%

December 1972

APPRAISAL OF SIXTH POWER PROJECT - EL SALVADOR
 COMISION EJECUTIVA HIDROELECTRICA DEL RIO LEMPA (CEL)
 ACTUAL AND FORECAST BALANCE SHEETS AT DECEMBER 31, 1969 THROUGH 1978
 (thousands of colones)

	1969	Actual 1970	1971 (See note A)	1972	1973	1974	Forecast 1975	1976	1977	1978
ASSETS										
Utility plant in service	133,469	156,539	166,753	168,185	197,631	201,706	249,352	440,592	458,385	460,835
Less: accumulated depreciation	27,230	30,807	34,875	39,163	44,843	50,966	59,095	67,362	79,634	91,759
Net utility plant in service	106,239	125,732	131,878	129,022	152,788	150,740	190,257	373,230	378,751	369,076
Construction work in progress	21,461	6,502	1,868	23,134	29,855	100,033	135,333	2,821	11,226	23,257
Net utility plant	127,700	132,234	133,746	152,156	182,643	250,773	325,590	376,051	389,977	392,333
Investment in Distribuidora Electrica de Usulután S.E.M.	100	300	300	300	300	300	300	300	300	300
Current assets:										
Cash and equivalent	1,722	1,592	7,567	8,389	5,895	359	60	1,597	17,430	31,767
Accounts receivable, less reserve	3,086	3,455	3,579	3,350	3,700	4,100	4,500	5,000	5,600	6,200
Materials and supplies	960	1,252	1,038	1,700	1,900	1,900	2,400	3,800	4,500	4,500
Prepaid expenses	78	166	183	200	200	250	250	300	300	350
Total current assets	5,846	6,465	12,367	13,639	11,695	6,609	7,210	10,697	27,830	42,817
Deferred charges:										
Studies of future projects	5,852	7,309	8,183	8,183	5,969	6,569	2,871	3,500	4,500	5,500
Other deferred charges	1,367	374	378	400	400	450	450	500	500	550
Total deferred charges	7,219	7,683	8,561	8,583	6,369	7,019	3,321	4,000	5,000	6,050
TOTAL ASSETS	140,865	146,682	154,974	174,678	201,007	264,701	336,421	391,048	423,107	441,500
LIABILITIES AND CAPITAL										
Equity	89,262	100,947	112,748	126,886	141,145	157,164	171,949	188,631	207,714	225,597
Long-term debt	46,002	43,644	40,088	45,542	57,362	104,837	161,372	198,917	212,793	213,503
Less: Amount due within one year	4,558	7,160	7,596	5,582	5,303	3,851	2,295	5,644	10,021	10,913
Net long-term debt	41,444	36,484	32,492	39,960	52,059	100,986	159,077	193,273	202,772	202,590
Current liabilities:										
Debt due within one year	5,558	7,160	7,596	5,582	5,303	3,851	2,295	5,644	10,021	10,913
Payables	4,057	1,729	1,752	1,850	2,100	2,300	2,700	3,100	2,200	2,200
Deposits	429	221	192	200	200	200	200	200	200	200
Total current liabilities	10,044	9,110	9,540	7,632	7,603	6,351	5,195	8,944	12,421	13,313
Deferred credits	115	141	194	200	200	200	200	200	200	200
TOTAL LIABILITIES AND CAPITAL	140,865	146,682	154,974	174,678	201,007	264,701	336,421	391,048	423,107	441,500

Note A: Utility plant in service and long-term debt have been increased by \$2,304 to reflect currency revaluation.

ACCOUNTING MATTERS AND THEIR SUGGESTED SOLUTION

1. CEL's balance sheet at December 31, 1971, did not reflect the increase in the amount of CEL's external debt caused by the various 1971 currency revaluations. This increase amounted to about $\text{Q}2.3$ million (US\$920,000), as detailed in Annex 11. During the appraisal mission, it was suggested that CEL should reflect this revaluation as of January 1, 1972 by:

- a. increasing the book value of its external debt to show the valuation computed by the Central Reserve Bank of El Salvador;
- b. increasing the value of its fixed assets by a corresponding amount; and
- c. depreciating the increased asset value over a period of 20 to 25 years, which would represent the remaining life of the assets.

2. As of December 31, 1971 CEL was carrying about $\text{Q}8.2$ million (US\$3.3 million) of studies as deferred charges on its books. These studies included expenditures associated with future projects and for other purposes as shown below:

	- - - - thousands - - - -	
Poza del Silencio	Q1,071	US\$ 428
Geothermal resources	4,898	1,959
Others	<u>2,214</u>	<u>886</u>
Total	<u>Q8,183</u>	<u>US\$3,273</u>

Since CEL had not selected a definite accounting treatment for these studies, the appraisal mission suggested that it establish the following procedure for capitalizing and writing off these studies:

- a. For any studies directly associated with a future project: capitalization when the project is commissioned and depreciation over its life.
- b. For all other studies not related to a project planned within the next five years at December 31, 1972 and each succeeding year-end: capitalization on the following January 1 and write-off over five years.

December 1972

APPRAISAL OF SIXTH POWER PROJECT - EL SALVADOR
 COMISION EJECUTIVA HIDROELECTRICA DEL RIO LEMPA (CEL)
 SOURCES AND APPLICATIONS OF FUNDS 1972-78

	1972	1973	1974	1975	1976	1977	Total 1972-1977	1978
SOURCES OF FUNDS								
Internal generation:								
Net income before interest	16,179	15,623	17,442	16,267	17,704	24,221	107,436	29,334
Depreciation	4,288	5,680	6,123	8,129	8,267	12,272	44,759	12,125
Total internal generation	<u>20,467</u>	<u>21,303</u>	<u>23,565</u>	<u>24,396</u>	<u>25,971</u>	<u>36,493</u>	<u>152,195</u>	<u>41,459</u>
Borrowings:								
Existing loan - IDA Credit 227-ES	13,050	950	-	-	-	-	14,000	-
Proposed loans:								
IDB loan	-	3,860	22,775	36,063	23,225	9,327	95,250	-
IBRD loan	-	12,592	21,753	19,323	11,793	2,789	68,250	-
Local borrowing	-	-	8,250	5,000	2,750	-	16,000	-
Total proposed loans	-	16,452	52,778	60,386	37,768	12,116	179,500	-
Future loans - foreign cost of Cerron Grande and geothermal extensions	-	-	-	-	2,072	7,404	9,476	10,531
Total borrowings	13,050	17,402	52,778	60,386	39,840	19,520	202,976	10,531
Government contributions - village electrification	-	1,300	1,300	1,300	1,300	1,300	6,500	1,300
TOTAL SOURCES OF FUNDS	<u>33,517</u>	<u>40,005</u>	<u>77,643</u>	<u>86,082</u>	<u>67,111</u>	<u>57,313</u>	<u>361,671</u>	<u>53,290</u>
APPLICATIONS OF FUNDS								
Construction program (including interest and fees during construction)								
Existing projects: Fifth project (gas turbine & line)	15,632	1,864	-	-	-	-	17,496	-
Acajutla gas turbine	-	6,250	-	-	-	-	6,250	-
Geothermal drilling program	1,625	1,375	-	-	-	-	3,000	-
Total existing projects	<u>17,257</u>	<u>9,489</u>	-	-	-	-	<u>26,746</u>	-
Proposed project:								
Cerron Grande - Units 1 and 2	800	10,838	49,687	67,348	47,215	12,977	188,865	-
Ahuschapan geothermal plant - Unit 1	2,691	9,029	18,508	3,761	-	-	33,989	-
Telemetering center	-	687	938	-	-	-	1,625	-
Training and studies	-	100	550	1,400	1,200	-	3,250	-
Interest and fees during construction	-	1,310	2,670	4,239	5,920	2,367	16,506	-
Total proposed project	3,491	21,964	72,353	76,748	54,335	15,344	244,235	-
Other: Future geothermal	-	-	-	-	-	-	-	1,000
Cerron Grande Unit 3	-	-	-	-	2,072	8,404	10,476	11,031
Village electrification	500	1,800	1,800	1,800	1,800	1,800	9,500	1,800
Other distribution and general	500	500	500	500	500	500	3,000	500
Other studies	950	200	200	200	650	1,150	3,350	1,150
Total construction program	<u>22,698</u>	<u>33,953</u>	<u>74,853</u>	<u>79,248</u>	<u>59,357</u>	<u>27,198</u>	<u>297,307</u>	<u>15,481</u>
Debt service:								
Interest charged to income	2,041	2,664	2,723	2,782	2,322	6,438	18,970	12,751
Amortization	7,596	5,582	5,303	3,851	2,295	5,644	30,271	10,021
Total debt service excluding interest and fees during construction	<u>9,637</u>	<u>8,246</u>	<u>8,026</u>	<u>6,633</u>	<u>4,617</u>	<u>12,082</u>	<u>49,241</u>	<u>22,772</u>
Additions to working capital:								
Other than cash	360	300	300	500	1,600	2,200	5,260	700
Cash	822	(2,494)	(5,536)	(299)	1,537	15,833	9,863	14,337
Total additions to working capital	<u>1,182</u>	<u>(2,194)</u>	<u>(5,236)</u>	<u>201</u>	<u>3,137</u>	<u>18,033</u>	<u>15,123</u>	<u>15,037</u>
TOTAL APPLICATIONS OF FUNDS	<u>33,517</u>	<u>40,005</u>	<u>77,643</u>	<u>86,082</u>	<u>67,111</u>	<u>57,313</u>	<u>361,671</u>	<u>53,290</u>
Cash at beginning of year	7,567	8,389	5,895	359	60	1,597	-	17,430
Cash at end of year	8,389	5,895	359	60	1,597	17,430	-	31,767

November 1972
 Revised January 1973
 Revised March 1973

APPRAISAL OF SIXTH POWER PROJECT - EL SALVADOR

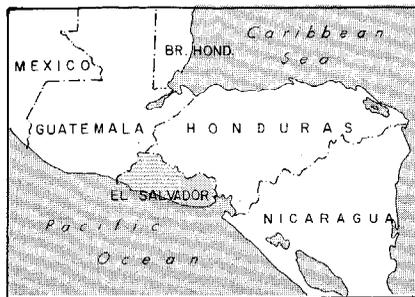
COMISION EJECUTIVA HIDROELECTRICA DEL RIO LEMPA (CEL)

ACTUAL AND FORECAST KEY FINANCIAL RATIOS

(Amounts expressed in thousands of colones)

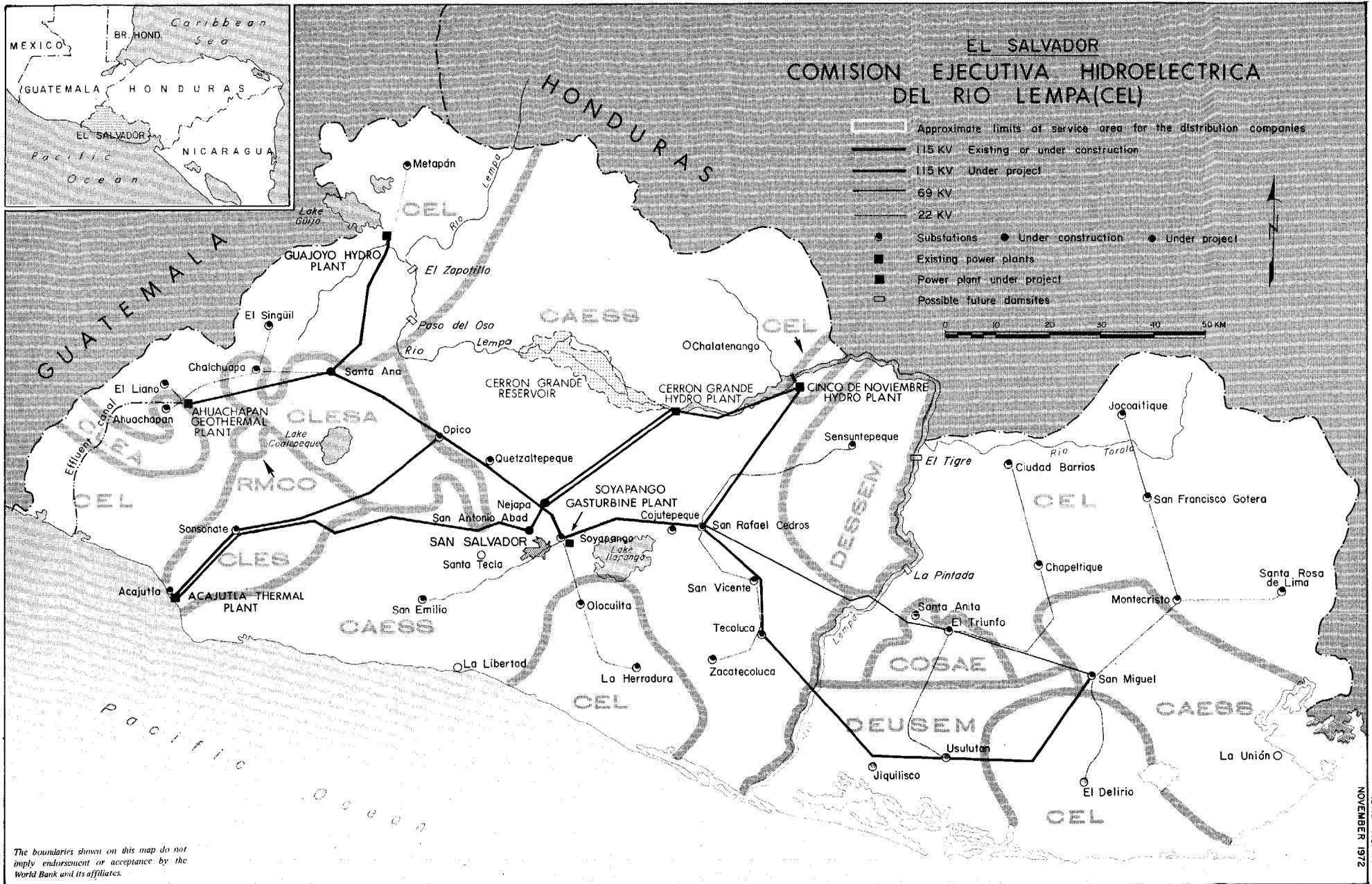
	Actual			Forecast						
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
<u>Return on Net Plant</u>										
Average net utility plant in operation	107,526	115,986	128,805	130,450	140,905	151,764	170,498	281,743	375,991	373,913
Net operating income	12,923	13,502	14,071	15,904	15,323	17,342	16,267	17,704	23,721	28,334
Percentage return	12.0	11.6	10.9	12.2	10.9	11.4	9.5	6.3	6.3	7.6
<u>Debt</u>										
Times debt service covered by internal cash generation	1.3	2.2	1.9	2.0	2.2	2.2	2.2	2.4	2.5	1.7
Debt/equity ratio	32/68	27/73	22/78	24/76	27/73	39/61	48/52	51/49	49/51	47/53
<u>Working Capital</u>										
Working capital at year-end	167	- 2,645	2,827	6,007	4,092	258	2,015	1,753	15,409	29,504
Current ratio (to 1.0)	1.0	0.7	1.3	1.8	1.5	1.0	1.4	1.2	2.2	3.2
<u>Depreciation</u>										
As a percentage of average gross utility plant	2.34	2.48	2.58	2.56	3.11	3.07	3.60	2.40	2.73	2.64

November 1972
 Revised January 1973
 Revised February 1973
 Revised March 1973



EL SALVADOR COMISION EJECUTIVA HIDROELECTRICA DEL RIO LEMPA (CEL)

- Approximate limits of service area for the distribution companies
- 115 KV Existing or under construction
- 115 KV Under project
- 69 KV
- 22 KV
- Substations Under construction Under project
- Existing power plants
- Power plant under project
- Possible future damsites



The boundaries shown on this map do not imply endorsement or acceptance by the World Bank and its affiliates.